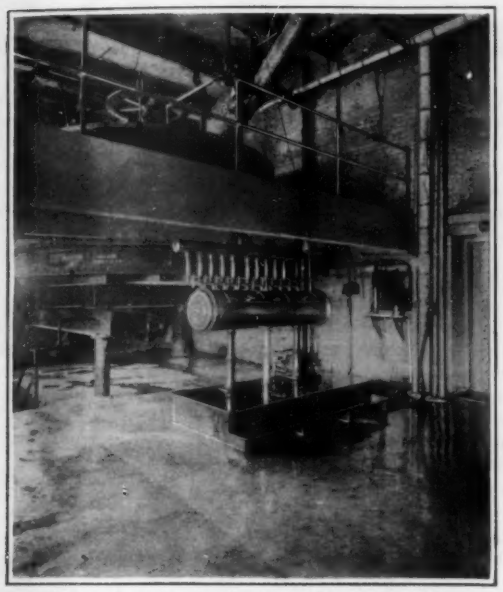
SEVENTY-THIRD YEAR

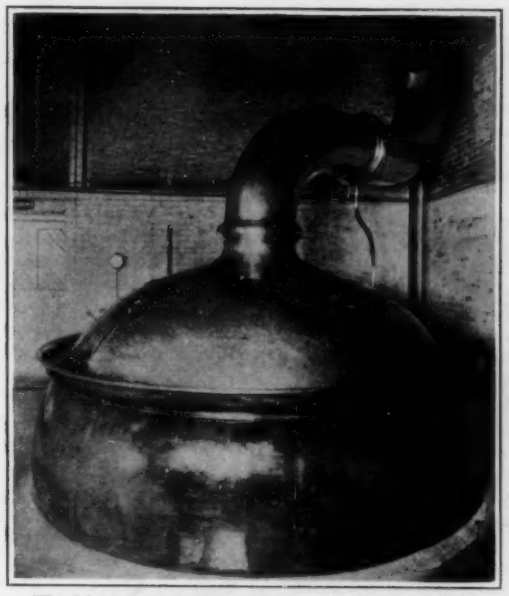
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

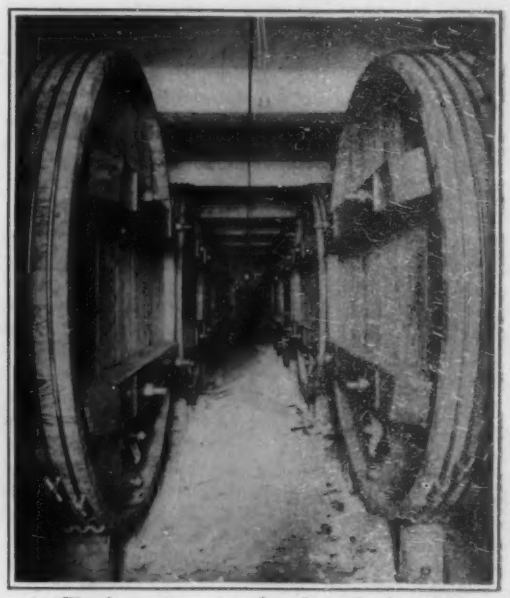
VOLUME CXVI.] NUMBER 14] NEW YORK, APRIL 7, 1917 [15 CENTS A COPY [$4.00 A YEAR



The mash tank, showing gear that operates the mixing kettles



The big copper boiler with false bottom in which brewing takes place



The huge storage tanks where the beer is kept to mellow

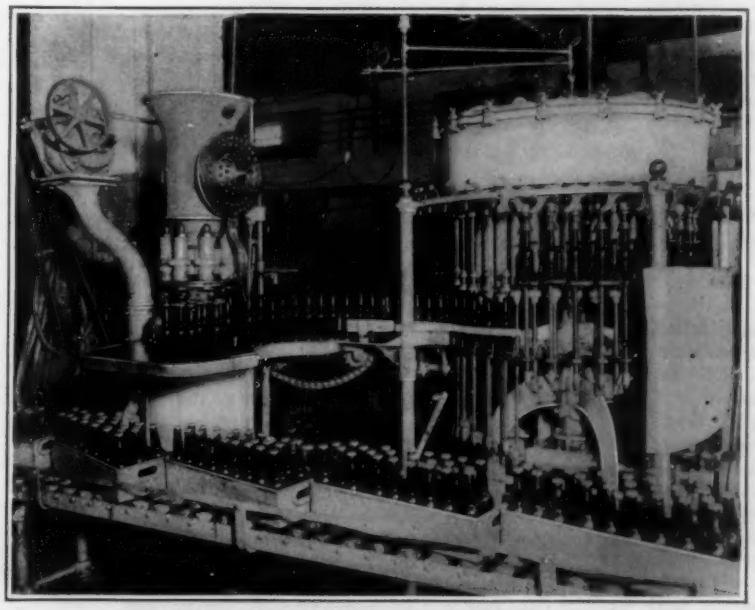
How Beer Is Made

By Ernest Elva Weir

BEER is an infusion of malted barley boiled with hops and afterwards allowed to ferment; and although the ingredients are few and simple, from four to six months are required to complete the various complicated processes involved in its production. The Egyptians manufactured beer 3,000 years ago, making the art of the brewmaster one of the oldest known to mankind.

The manufacture of beer commences in the mash tank, a large enamel-lined receptacle, where malt and hot water are placed in proper proportions. This tank has a false bottom through which live steam is admitted to maintain the required temperature. The mixture is agitated by machine-driven revolving paddles and the resultant golden-colored liquid, called wort, is filtered through the grain of the mash into the false bottom. From here it is drawn off and conducted through copper pipes to the brewing kettle, an immense copper boiler, also provided with a false bottom. After the addition of hops, the liquid is boiled until the hops yield their full flavor. Heat is applied by live steam passed into the kettle and kept in circulation by a natural draft through an exhaust flue from the top of the kettle to the open air. The hops, the ingredient that gives beer a bitter taste, are added gradually during the boiling period in three or more different parts.

After the wort and hops have been sufficiently boiled, the embryo beer passes to a third tank known as the hop jack where the residue of the hops is filtered out. The liquid is then cooled by running over a series of horizontally arranged copper pipes, the top one filled with cold water, the lower ones with freezing brine. A trough catches the liquid after its descent and diverts it to pipes leading to settling tanks, where yeast is added. Here it is allowed to stand overnight and then flows to wooden fermenting casks, remaining there from two to three weeks. At the end of that period it is called "young beer," but still has some distance to go before it is ready for the consumer. The fermenting tanks are coated inside with a special varnish immune to the chemical fermentive action.



Rotary bottle-capping machine, with conveyor

The machine picks the empty bottles from the constantly moving conveyor, automatically fills each one with the correct quantity of liquid, and clamps the cap in place. Then another conveyor removes the sealed bottles.

The apparatus for filling the kegs

The fermentation set up by the yeast covers the liquid with a brownish cream that gradually increases in volume by the rapid multiplication of the yeast cells. During the first twelve to eighteen hours fermentation proceeds slowly, but afterwards gains in vigor accompanied by a rapid rise in temperature and a correspondingly rapid decrease in specific gravity. To control better the finish of this process, the contents of the fermenting tun are generally transferred to some intermediate vessel after about forty hours.

When the fermenting is completed, the beer is run to storage tanks where it is kept for three to four months to mellow, age and become digestible. It then flows to the chip cellar, so called because thin chips of beechwood are placed in the tanks receiving the beer. This practice is explained by the fact that particles of yeast, hops or malt which have escaped the previous filterings have a peculiar affinity for these chips. When the beer is drawn off, it is quite clear, the chips having fallen to the bottom of the tank through the weight of the clinging sediment. After another filtering, the beer is pumped under pressure through blocks of pressed wood cellulose, linen and cotton, a process that extracts every remaining trace of sediment and leaves it as clear as crystal and of a light amber color. It is now conveyed to glass-lined steel tanks in rooms of a freezing temperature. There it is kept until piped to the bottling and barrel filling machines.

While each brewery has its own method of bottling, capping, labelling and pasteurizing, in all up-to-date institutions, ingenious machines accomplish these things quickly and thoroughly. For instance, there is a rotary bottler which automatically picks up the empty bottles from a conveyor, raises them by compressed air, opens a valve and admits the right quantity of beer into each. And conveyors are universally used to carry empties from the bottle washer to the bottler as well as filled bottles to the pasteurizer, crowning and labelling machines and finally to the packers. Kegs are filled by another piece of apparatus.

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, April 7, 1917

Charles Allen Munn, President, Frederick C. Beach, Secretary, Orson D. Munn, Treasurer, all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Germany's Submarine Effort

IN war, perhaps more than in any other contest of strength, it is perilous to underestimate the resources and strength of the enemy. That is one of the truisms which are so true that we are in danger of overlooking them altogether. Thus, in regard to the German submarine campaign, we note that there is a tendency to underestimate its potential danger to the Allies, and therefore, in the event of its success, to ourselves.

It is generally believed that the submarine-infested areas are so completely covered by the anti-submarine fleets of the Allies, that the strength of the German attack is constantly being weakened by very large losses; but if we analyze the testimony, and apply to it the cold criticism which we would use in any other enterprise; in other words, if we brush aside unauthenticated rumors and confine ourselves entirely to official statements, we shall find that the Allied governments have never made any definite statement whatsoever as to the number of German and Austrian submarines that have been captured or sunk.

It is only recently that this journal has been able to obtain a conservative estimate, in quarters where reliable statistics are available; and we are informed that a total loss of one hundred would be, if anything, an over-statement of the truth. This figure includes many boats which were supposed to be lost because they were believed to have been heavily hit by shell-fire.

For some months we have had a growing conviction, based upon a very close study of the campaign, that the submarine losses were not nearly so large as represented and that with the growth in size, speed and sea-keeping qualities of the submarine, the problem of meeting and breaking up the so-called blockade is becoming increasingly difficult.

It is our belief that at the time of the Jutland fight, when the German High Seas Fleet was driven back, with heavy losses and in a badly battered condition, to its naval bases, Germany, realizing the hopelessness of any attempt to defeat or break through the British fleet, determined to cease all work upon the construdtion of capital ships and bend its whole ship-and-engine-building capacity to the creation of a great fleet of submarines for war upon enemy and neutral commerce. Saving and except that this was an utterly illegal form of warfare, the Germans were perfectly right in stating that herein lay their "last chance of victory." For it is a fact that, granted a sufficiently large fleet of submarines, the Allies can be, if not starved, at least so hampered by a shortage of food and raw materials for the manufacture of guns, shells and military equipment, that they will be unable to win such an absolute victory as to enable them to dictate the terms of peace. This is the situation as Germany sees it to-day. She has stated that it is her purpose to force the Allies to a compromise peace, and whether she can do it or not depends first and last upon her ability to set afloat and man, within a definite period of time, the thousand or more submarines which would enable her thus to bring the Allies to their knees.

What is the German submarine-building capacity? Is it sufficient to enable her, say within the year, to build, equip and man a thousand or twelve hundred boats? Nobody outside of Germany can answer that question; but the SCIENTIFIC AMERICAN believes that she is probably well able to do this, provided, of course, that she is not herself brought to her knees through collapse of her finances, through starvation, or by the absolute overthrow of her armies.

Of course, the only plan by which Germany could build a thousand submarines in a year, would be by what has come to be known as the manufacturing method, of which a notable example is found in the great Ford plant at Detroit. It is pretty safe to say that she has adopted a standard type of craft, the details of which are based upon the experience of the past two and a half years, and that she has enlisted the whole of her shipbuilding plants, public and private, and a corresponding number of her engine-building firms, in this work.

We have made investigation of the capacity of the German yards as regards building ways, and it discloses the interesting fact that, without laying down any additional ways, she could have under construction at any given time about 530 submarines of the size of the U-53 which came to Newport last year. The 800-ton submarine requires about 30 feet of clear width in order to allow a working space around the hull, and its length is something under 250 feet. Each of the three 625-foot dry-docks at Wilhelmshaven, for instance, would permit of the construction of six submarines on its floor, and eight boats could be constructed in each of the larger docks, 822 feet in length. Also the floating docks, of which the Germans have so many, would form excellent building ways. The smaller dry-docks, 500 feet or less in length, and the floating docks would take two, three or four submarines, as the case might be. Moreover, ways suitable for submarine construction can be built rapidly on foreshore or riverbank, and the actual shipping and dock-yard capacity, so far as building ways is concerned, could quickly be doubled. If the Germans thought fit, they could have a thousand submarines under construction at the same time.

The limiting factor as to time-capacity, however, would not be the provision of ways, or even the construction of the hulls, but rather the rapid construction of the internal equipment. Of this the engines would present the least difficulty; for Germany is the great Diesel-engine country, and if they extended themselves in a concerted effort of this kind, the leading heavy-oil engine builders, such as Krupps, the Emden Works, the Augsburg Works and the Neuremburg Works, reinforced by less known firms and the large number of engineering plants which could be requisitioned for this work, would be well able to take care of the demand. The principal difficulty would be to supply the special apparatus in the way of periscopes, gyroscopic compasses and the other mechanical details, which must be of the very finest workmanship and require special knowledge and skill. Germany, however, is famous for her optical work, and unless there was a shortage of the materials required, the instrument makers should be able to keep pace with the shipbuilder and the builder of engines.

As to the time for construction, one large shipbuilding firm in this country has assured us that if its plant were doing nothing else, it could turn out a submarine of the German type in five months' time. Our Naval Construction Corps estimates that it would take seven months. If Germany is concentrating her whole shipbuilding resource upon the task, we believe that six months might be taken as a fair average.

The Central Powers may have two hundred submarines afloat, (and we think it is possible that they have many more than that) and if, as is more than likely, they have some five hundred on the ways at the present time, this would mean that in six months they would have seven hundred U-boats available, and twelve hundred by next spring.

But the crews? The German naval personnel numbers over 150,000 men. Her idle battleships can supply all the men required to man the submarines as they are successively set afloat.

Here, as we see it, is the immediate danger point in this great conflict into which we have now entered. It is here that we should apply, and should at once apply our whole effort. If we refuse to do this, and elect to fight a purely defensive war, and the Allies should have to make a peace favorable to Germany, we may ultimately find ourselves face to face with the High-Seas Fleet of Germany, and the veteran armies, ten millions strong, of the four nations of the Central Powers.

Clandestine Wireless Stations Here and Abroad

AMONG the many rumors that figure in the news of the day there are not a few which tell of the establishment of clandestine wireless stations both in the remote sections of the United States and in Mexico and the Central American republics. Whether these rumors are well founded or not, from a purely scientific point of view they are of considerable interest because of the possibilities which they suggest at this time.

For two years, more or less, the German army of occupation in Belgium was troubled by the activities of a Belgian newspaper which, strangely enough, was edited, printed and distributed by unknown persons. Rewards offered for information leading to the discovery of the persons connected with this little newspaper failed of result, so patriotic have been the Belgians. Despite every precaution on the part of the German authorities, the little paper appeared regularly and found its way to the thousands of readers.

Now the main point of interest in this story is that the little Belgian newspaper was always in a position to publish the latest war news from England and France. It made no secret of the fact that the press despatches from the British and French radio stations were regularly received at a concealed wireless station; and, obviously, these despatches were often at odds with the German official reports, with the result that the activities of the Belgian newspaper were necessarily embarrassing to the Teuton invaders. According to last reports the Belgian newspaper was still being published, and the clandestine wireless station was at work every day, picking up the war news sent out by the Entente radio stations and distributing it among the Belgians.

What has been done in Belgium can readily be repeated in the United States. And it is a known fact that wireless apparatus has been found among the paraphernalia of certain of the German plotters who have been apprehended by the authorities.

Of what use are these wireless instruments?

To answer this question it would be necessary to know something of the alien plots which are as yet undiscovered. But from a technical standpoint it is known that with the most inexpensive receiving apparatus it is possible to receive messages from abroad. Thus the average wireless amateur in New York City, using the Armstrong regenerative tuning circuits and a valve detector, has no difficulty in nightly picking up the press and other despatches emitted by the German radio stations, such as Nauen and Eilvese. And what these youngsters can do, others can do; and if some understanding exists between the German authorities and their secret agents in this country, it may be said that the two are in virtual communication at all times, even admitting that the communication is but one way.

As to the situation in Mexico and Central America, the presence there of wireless stations owned and operated by German interests would be most serious; for in the case of stations on United States soil, they must confine their efforts to receiving only or risk quick detection, while on neighboring soil they can operate with impunity, not only receiving instructions from Berlin but also transmitting messages across the ocean and to submarines and raiders operating in our waters.

Should there be any truth in the rumors now current, it would be well for our authorities to pay careful attention to the operation of clandestine wireless stations, and to take drastic steps at the first signs of mischief aimed against our National defense, from this direction.

Nature's Hot Air Furnaces

IN severe winter weather range cattle in the Bad Lands of western North Dakota are seen now and then congregated about a great fissure in a red, naked hillside. Investigation shows that a warm current of air rising through the fissure from a burning coal bed underneath has attracted them.

It is not difficult for the herds to find such natural warming places in the Bad Lands. The 1400 square miles comprising the "Terres Mauvaises," as the early French travellers named the region, are underlain with lignite coal beds varying from an inch to forty feet in thickness. There are few of these beds that have not been burnt, at least where they outcrop at the surface. Some are entirely consumed; many, it is believed, have been burning for hundreds of years; others have been set afire accidentally by ranchers and campers in recent years. Prairie fires undoubtedly have ignited some of the beds.

Whatever the cause, the fires are there, creeping farther and farther back through the region and annually consuming thousands of tons of coal. As they burn, the clay beds above the lignite coal settle and great cracks open. Air enters through these cracks, giving impetus to the fires. Meantime, the intense heat melts the clay, changing it into a jagged mass of red and pink clinkers. These beds of clinkers so frequently and so brilliantly cap the buttes and crags of the "Bad Lands" as to give the entire region the appearance of "having been deluged with blood" as one traveller has expressed it. Some times the clay bakes in place of melting and then beds of natural brick are formed. The Northern Pacific used great quantities of this natural brick in building through western North Dakota.

The presence of these beds of burnt clay and clinkers has led many to believe that the Bad Lands are of volcanic origin, but the geologists say that running water, not volcanic force, is responsible for the vast tumbled waste of bare flat-topped buttes, the deep valleys and coulees with sides so steep that even wild beasts find them impassable, the countless smaller cone-shaped hills piled one atop the other or clustered like beehives in an apiary, and the fantastic groups of pinnacled and tabled rocks.

The hills, whatever their shape, are nearly all downward-streaked with deep crooked furrows and lined horizontally in precision with layer upon layer of gray shale, black coal, red clay, and yellow and white sandstone. In past ages the turbulent Little Missouri River and its many branches, big and little, ably assisted by frost, heat, rain and snow, have wrought this stupendous havoc. So rapidly does erosion go on that vegetation is baffled in its attempt to take root on the slopes and the hills stand bare of even a trace of green the year round.

Electricity

Regulations for Electric Concessions in Panama.—The Government of Panama has decreed that only the executive may grant concessions for the use of land and water for the production and distribution of electric light and power. The law as published in the *Gaceta Oficial* stipulates that concessionaires, in return for specified exemptions, must agree to grant the government a part of their gross proceeds from electric service, and to furnish electricity for public purposes at a reduction of not less than 25 per cent from the rates charged private consumers. Companies installing electric light in a city of at least 45,000 inhabitants must transmit their current underground. Contracts executed by the executive in conformity with this law will not require legislative approval.

Telephonic Reception of Cable Messages.—It appears now that the telephone receiver may take the place of the Kelvin siphon recorder in the reception of cable messages at no distant date. Recently a number of experiments were carried out under the direction of Lieut.-Col. G. O. Squier, in which the receiving apparatus made use of the "ticker" principle and the audion, both of which figure prominently in the wireless apparatus of today. The cable used for the test was 1,086 miles long, and the actual receiver was an ordinary telephone. The feeble current received was broken up by means of the sliding contact "ticker" and rendered audible, and in order to secure greater sensibility, a tuned audion amplifier was used in connection with the "ticker." It is reported that the sensitiveness of the apparatus is so great that less than one-twentieth of the voltage necessary for operating the siphon recorder is sufficient to give good traffic signals.

Sensibility of Present-Day Radio Apparatus.—Given a small, low aerial, it is not uncommon for the average American radio amateur to receive messages over a radius of several thousand miles from Government and commercial stations. And, what is more, the amateurs can hear each other at distances well over a thousand miles in many instances, even if their transmitters are usually of one kilowatt or less. Amateurs in New York City have no difficulty in reading the signals of amateurs in the Mississippi Valley; in fact, amateur stations as far west as Dallas, Texas, are often heard. As to what can be done without an aerial, a correspondent of the *Wireless Age* states that he has recently designed and built a receiving instrument with which, by using only one vacuum valve, he is able to read stations at a distance of 600 miles and more, without any antenna whatsoever. In fact, he states, there is nothing connected to the aerial binding post of his apparatus, nor is there an aerial within a mile of his residence. All he uses for the ground connection is a wire connected to a small piece of iron stuck in the earth.

Improvement in Public Lighting in London is reported in a recent issue of *The Electrician*. A welcome change has just been made in the lighting conditions by causing the lanterns of public lamps to be blackened only over a short length of the upper portion, the lower and larger part being covered with special translucent whitewash. The method has already been introduced into many of the chief thoroughfares. It has the merits of eliminating the bright patches under the lamps, making the general illumination both brighter and more uniform, and diminishing the severe contrasts which were a disagreeable feature of the methods of screening previously employed. In the present darkened condition of the streets the shielding of the lamp filament or mantle by the diffusing coating of whitewash is also a good feature, with a view to reducing glare. That many dangers arise from darkened streets is borne out by the report that in the Metropolitan area of London, during the hours of darkness from August1st, 1914, to January 31st of last year, the number of fatal street accidents was 954, and the number of persons killed by Zeppelins during the same period was only 137.

An Improved Telephone Transmitter.—A recent British patent deals with telephone transmitters and has for its object the elimination of the risk of damage to the parts when being assembled together, and a further object of providing a case that will be practically water-tight and damp-proof, and not liable to damage in ordinary usage. Instead of using simply a carbon diaphragm, a carbon plate or electrode is employed in combination with a protective metallic or ferrotype diaphragm, the two forming what may be termed a compound diaphragm. The protective diaphragm fits like a lid over the mouth of the container, and is secured water-tight thereto. The jointing may be effected either by providing the diaphragm integrally with the turned-up cylindrical flange, which is bent over a corresponding flange or edge on the case, or by means of a separate flanged ring, which may be bent over the edges of the diaphragm and the case, so as to grip them tightly between its flanges, the surfaces being previously covered with white lead if desired. In addition the non-vibrating electrode, having grooves for the pellets or granular material, is secured to the case by a water-tight fixing.

Science

The Tortugas Marine Laboratory.—On account of the abandonment of the U. S. naval base formerly maintained at Tortugas, the Department of Marine Biology of the Carnegie Institution feels compelled to remove its laboratory from that place. The only means of communication with the world is through Key West, sixty-eight miles distant, and transportation of supplies, etc., would absorb too much of the time of the yacht "Anton Dohrn," attached to the laboratory, and specially designed for oceanographical researches.

How Cats Turn in the Air.—Drs. H. R. Muller and L. H. Weed have published some "Notes on the Falling Reflex of Cats," presenting the results of an experimental study of the rotational reflex by which cats are able to turn in the air while falling and to land squarely on their feet. They find that either the vestibular apparatus of the ear or the optic system is able to give rise to impulses during falling that produce this movement. Normally, both mechanisms appear to be employed during the fall, but if either one is experimentally eliminated, its absence does not interfered with the reflex. When both are lacking, however, the reflex does not take place.

Collecting Human Embryos.—Dr. Franklin P. Mall, of Johns Hopkins Medical School, director of the Department of Embryology, Carnegie Institution, began collecting human embryos twenty-five years ago, and in the first ten years of that period collected 100 specimens. The collection has since been taken over by the Carnegie Institution and is now growing at the rate of 400 specimens a year. More than 500 physicians have contributed specimens. Missionaries and physicians in foreign countries have added to the collection, in which several races and nationalities are now represented. Dr. Mall states that over 140 publications have been based in part or entirely on this remarkable collection.

A Great Treatise on Cactus.—The great monograph on the cactus family which Drs. N. L. Britton and J. N. Rose have been preparing for some years has made such progress that the manuscript and illustrations for four volumes are now largely prepared. The first will cover the tribes *Pereskieæ* and *Opuntieæ*; the second, the *Cereæ*; the third, the subtribes *Echinocereanæ*, *Echinocactanæ* and *Cactanæ;* and the fourth probably the subtribes *Coryphanthanæ*, *Epiphyllanæ* and *Rhipsalidanæ*. Besides work in museums, greenhouses and herbaria, explorations have recently been made in northern Cuba and expeditions are planned to Venezuela, Paraguay, southern Brazil and northern Argentina. After this program is carried out, the only extensive cactus region requiring exploration will be that of Ecuador.

The Cultivation of Guayule.—The last report of the Carnegie Institution of Washington records the successful attempts that have been made to bring under profitable cultivation the desert rubber plant, guayule. The wild shrubs have long been collected in great quantities in Mexico, and the rubber, which grades much lower than Para, is extracted by such simple processes as to make its production very profitable. The task of developing methods of cultivation, says the report above mentioned, has now been successfully accomplished by Dr. W. B. MacCallum, who, in making a genetic analysis of the plant, has found that it includes several elementary species, which do not readily interbreed. Studies of the plant have been made at the Desert Laboratory, Tucson, while in the same neighborhood a company has purchased 7,000 acres of land on which to establish guayule culture. This is the only rubber-producing plant growing within the borders of the United States.

Mountaineering Possibilities.—At a recent meeting of the Royal Geographical Society, Dr. A. M. Kellas presented an elaborate discussion of the question whether it is possible for well-trained mountaineers to ascend to the summits of the loftier peaks of the Himalaya, mountains over 25,000 feet in altitude, none of which have so far been climbed. The present altitude record in mountaineering is 24,600 feet, by the Duke of the Abruzzi's expedition to the Karakoram, 1909. The altitude of the highest mountain in the Himalaya and in the world —Everest—is 29,141 feet. At that height the barometric pressure and the oxygen supply is only about one-third as great as at sea-level. The experiences of balloonists is not conclusive as to the physiological difficulties of such an ascent, because the rapid rise of a balloon does not give the aeronaut time to become acclimatized to great altitudes. On the basis of a large amount of data Dr. Kellas (himself an experienced mountaineer) expresses the opinion that a man in first-rate training, acclimatized to maximum possible altitude, could make the ascent to Mount Everest, provided the physical difficulties are not insuperable. A supply of sodium peroxide, to provide oxygen as an occasional refreshment would be of much assistance. At present one of the "physical" difficulties of ascending Everest is the fact that the Government of India will not let travelers approach within 100 miles of the mountain.

Automobile

Helical Toothed Gear Box.—It is reported that a Swiss engineer has invented a helical toothed gear box for motor vehicles in which the end thrust is overcome by equalizing the tooth pressures. This is attained by suitably proportioning the number of teeth in the gear wheels, and carefully arranging the tooth angles.

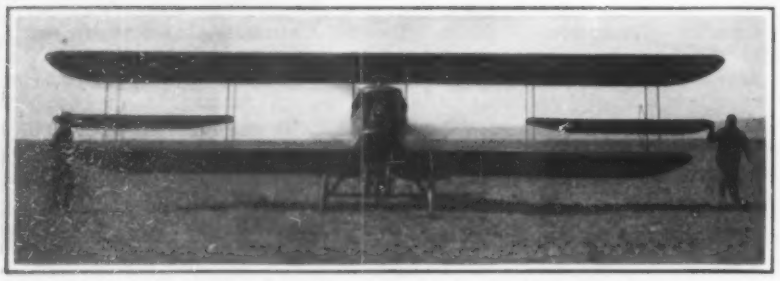
The Cost of Maintenance.—Fabulous figures are frequently published relating to the amount of money invested in this country in automobiles, but it is only recently that people have begun to figure up what is expended annually on their maintenance, not counting the cost of gasoline or lubricating oil. In a recent article in *Automobile Topics* it was estimated that by mid-summer there would be close to four million cars on the road in this country alone, and that $3,080,000,000 will be spent during the year in sustaining them. At this rate the profits on accessories will soon surpass those accruing from the manufacture of the cars themselves.

An Opening for American Farm Tractors.—The scarcity of food in England has impressed upon her people the necessity for obtaining a greater product from her available farm lands, and the conclusion has been arrived at that the most powerful agent for attaining this end is the farm tractor, and intense interest is consequently being shown in this class of machinery. As America has done more toward the development of this class of machinery than any other country its tractors have secured great prominence before the British public, and there is a most valuable field open to any of our manufacturers who will supply power farm machinery of sound design and construction.

Poisonous Gases.—In a recently published book on gasoline the following significant statement is made which should be remembered by every owner of a car: "If a gasoline engine, producing 5 cubic feet of CO per minute, were allowed to run in a tightly-closed garage that was 12 feet high, 15 feet long, and 15 feet wide, that is, having a capacity of 2,750 cubic feet, it could produce an atmosphere, if the latter were thoroughly mixed, containing about 1 per cent CO in about five minutes. This percentage of CO in air is a fatal proportion, and would probably kill a person in less than a minute. In fact, an exposure for as long as twenty minutes to an air containing as little as 0.25 per cent CO would make most people very ill."

Attention to Brakes.—Few things are more prolific of accidents than poorly operating brakes, but like so many other things it is a case of out of sight, out of mind, and no thought is given to the brakes of a car until something happens, regardless of any indications of defects or poor adjustment that may have gone before. That positive action is desirable to control such conditions is indicated by remarks made by a member at a recent meeting of the Society of Automobile Engineers. He said: "If I were a Police Commissioner I should like to enforce one law, and that is this: An inspector should be able to go on any car, provided the road is dry, and say of asphalt or good macadam, cement or brick, and make a brake test going at say 20 m.p.h. and within certain limits, and if the car does not stop, he should have as much right to take the driver into the police station as for breaking the speed limit. If that were done there would be fewer accidents. I think we should advocate it as leading to a solution of some of the automobile accidents. The headway between automobiles is much less than it used to be, and people are so accustomed to them that they have become more careless. I think we ought to help the police authorities in their problem."

Vaporizing the Gasoline of Today.—Everybody knows that the gasoline now on the market is far more difficult to properly vaporize than that obtainable a few years ago, because, owing to the increased demand, it has been necessary to utilize the heavier products of distillation, and also to create mixtures of heavy and light distillates. As a result, whereas with the old light fuel, the carbureter gave a well vaporized mixture, now, as a matter of actual fact, the best that can be secure is a finely divided spray of the liquid in air, some portions of which are deposited in the manifold, while a considerable portion enters the cylinder in drops, which do not contribute to power, but simply burn, and deposit carbon. It seems evident that to insure a proper mixture reaching the cylinder special attention must be given to the design of the manifold, and this has been done in a device recently brought out which is adapted to be fitted to a number of popular makes of cars in place of the regular manifold. In this the inlet and exhaust manifolds have been so combined that all solid fuel that reaches the inlet manifold is converted into vapor by the heat of the exhaust gases. As all of the fuel that passes through the carbureter is converted into an explosive mixture not only should there be an increase in power, but there should be a saving in gasoline, and the accumulation of carbon in the cylinder should be reduced.



"Trimming" a military tractor in leaving the ground

A military tractor biplane just before leaving the ground. In gusty weather the mechanicians steady the ends of the lower planes, sometimes turning the machine by holding one edge and pushing the other.

The Glenn Martin type of biplane used at the San Diego school

The flying radius of this machine with normal equipment and two passengers is 300 miles. It has an 80-horsepower engine, a wing spread of 38 feet 10 inches, and a length of 21 feet 6¼ inches.

Airmen and the Weather Bureau—Partners

The Meteorological Work Undertaken at the San Diego Army Aviation School

By C. L. Edholm

CLOSE coöperation between the United States Weather Bureau and the Army aviators is indicated by a report of the forecaster, Dr. Ford A. Carpenter of Los Angeles, regarding the activities of his office in connection with the War Department school of aviation at San Diego, in southern California. That the interest of this distinguished meteorologist in aviation is not merely academic was demonstrated recently when he made a flight from the school on North Island, in order to study at first hand certain dangerous wind conditions which are usually to be found over Point Loma. This is the first time that a United States weather observer has made an aeroplane flight, and it was done partly to ascertain by experience the problems that confront the flier and so to be of greater service in helping solve these problems.

For many years the relations between the weather man and the airman have been mutually helpful. The laboratories for the study of the upper air have secured information of the greatest value regarding air currents, their direction and velocities at levels up to twenty and one-half miles, as well as the temperatures encountered at various altitudes. In 1914 the Weather Bureau and the Army Aviation School coöperated officially for the first time when Dr. W. J. Humphreys, Professor of Meteorological Physics, was detailed to deliver a series of lectures at the school, one of which, "Holes in the Air," has been reprinted for use there as a text book. Previous to that date, however, there had been active though unofficial coöperation; in fact Dr. Carpenter's knowledge of weather conditions at San Diego was of value in helping select the site for the school on North Island, a location which is ideal for beginners because of its climatic as well as topographical advantages.

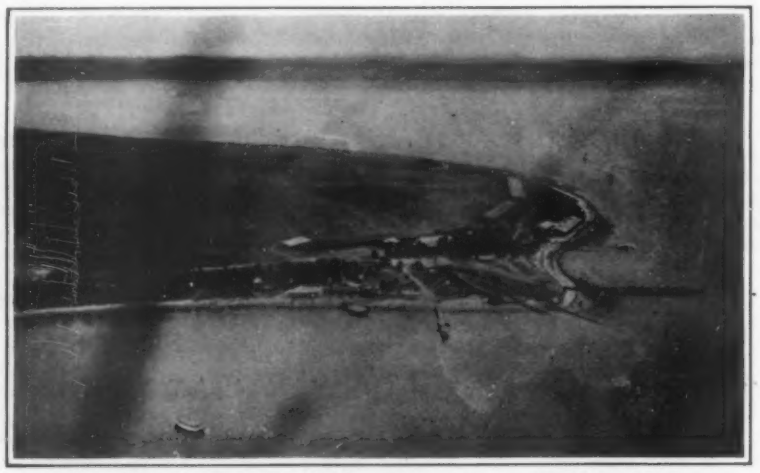
Gradually the Weather Bureau and the Aviation School have come in touch until now there is hardly a day without a conference between the officer-instructors and the forecaster. During the cross-country flights of April and May, 1916, forecasts of flying conditions were issued to the aviators. Special observations of wind, weather and fog conditions were made from the coast near Los Angeles, and from the Weather Bureau coöperative station at the Mount Wilson Solar Observatory. From the latter point, with an altitude of 6,000 feet, reports of fog heights were secured, which were of particular value. This station commands a sweeping view of the coast from Point Firmin, overlooking Los Angeles harbor, to Point Loma on San Diego Bay. Knowing the different levels, the observer stationed on Mount Wilson was able to report the actual thickness and extent of the fog belt, its history for the previous twenty-four hours, and a satisfactory forecast regarding it.

Not content with receiving and analyzing the daily weather forecasts, the officers at North Island are teaching the fundamentals of meteorology to the students of aviation. Lectures are given on temperature and its distribution, and on winds, moisture and clouds, one of the text books being a reprint of "Clouds of California," a weather bureau paper by Dr. Carpenter. The Bureau has furnished a standard set of meteorological instruments for use at the station, in order to familiarize the airmen with the equipment and its use. The application of this theoretical knowledge to the wind and weather conditions encountered in their daily flights, forms part of the training of the fliers.

One of the staff instructors investigated varying wind directions, making use of small parachutes which are dropped at various altitudes. Duplicate signal sheets were provided by the Bureau station at San Diego, from which the student-officers make their own weather maps. From them and from their own flights, they could arrive at some relationship between the actual and theoretical 3,000 and 10,000-foot level maps prepared by the Bigelow formula, as used by the Bureau.

By placing at the fliers' disposal the information gathered by the meteorologists, and by instructing the aviators in the fundamentals of the science, so that they apply the information to the problems encountered in flight, the Weather Bureau adds greatly to the efficiency of our airmen and lessens the dangers of their calling.

The final link in the chain of service between the Weather Bureau and the aviation school was the flight of a scientist who had for twenty years studied conditions from the ground and from the records of balloons sent aloft with recording instruments. Fifteen years ago Dr. Carpenter began his study of aviation at San Diego, assisting Octave Chanute, who made photographs and observations of the flight of gulls and pelicans, developing facts which the Wright brothers put to use in their designs. Since then his association with the Wrights and Curtiss has kept him in intimate relation with the science, but in spite of that he felt that the weather man who is to be of most assistance to the airman must have actual experience in flying. Besides getting the aviator's point of view, Dr. Carpenter had the specific object of ascertaining the height of the upward trend of a certain treacherous wind over Point Loma, an area which is shunned by the novice. Also he desired to observe the extent, form and composition of the velo cloud, the characteristic sun cover of California.



United States aviation field at San Diego, Cal., at 2,000 feet altitude

The ascent was made in one of the tractors used at the Aviation School, an 80 horse-power machine made by Glenn Martin in Los Angeles. Captain Oscar Brindley, 1915 winner of the Curtiss trophy, was pilot. The propeller was started and the machine headed into a 30-mile wind and in a few seconds the aeroplane was ascending at a gradient of one to seven. Very soon an altitude of 3,000 feet was reached and then, according to the plan, the aeroplane was plunged into the "aerial breakers" over Point Loma. This ridge that projects into the Pacific at an altitude of 500 feet deflects the prevailing northwesterly wind upwards, and causes disturbances that are felt by aviators and seamen alike. Topsails of schooners have been carried away by these twisting air currents, which are known locally as "woolies," because they churn the surface of the water into isolated patches of foam like tufts of wool. Seen from the aeroplane, Point Loma looked like the backbone of some monstrous fish projecting above the sea, and the approach into the disturbed area was presently felt. The tractor shivered under the impact of two distinct blows, as perceptible as though the fuselage had been struck with a stuffed club. There was a surge and then a sudden drop, for a descending current had been encountered that deprived the aircraft of support. This condition has been observed by aviators as high as 4,000 feet, though the ridge that causes it has a height of only 500 feet.

The aeroplane was making a speed of 70 miles an hour against a 30-mile wind, and as the pilot prepared to change the course, the observer felt some apprehension,

(*Concluded on page 355*)

Instructor Brindley and Meteorologist Carpenter starting on a flight

In cranking an aeroplane engine the aviator short-circuits the ignition system while the mechanician turns the propeller to introduce the explosive mixture into the cylinders. The cylinders are then fired.

Lieut. H. A. Dargue testing his engine before flight

The power of the engine is observed by the clouds of dust kicked up by the propeller, and the energies of the four men that are required to keep the machine from progressing.

Women-Chemists in Wartime

By Dr. Alfred Gradenwitz

THERE are perhaps, few professions for which a woman is better fitted than that of chemistry. Her household work affords excellent training for the handling of test-tubes, retorts, crucibles and stills; and her natural conscientiousness even in matters of minor import, her soundness of judgement and her sense of practical realities are invaluable qualities in a laboratory worker. Still there was much prejudice to be overcome, before the first women-chemists found their way into the workshops of chemical industry, and though they all made good, the last barriers—at least in Germany—were not removed before the present war which, in this, as in so many other fields, necessitated appeal to the coöperation of women. Not only in analytical laboratories, but in metallurgical works and institutes of bacteriological and metal research, women are filling the posts formerly held by men, and as far as present experience goes, they have proved to be most competent workers.

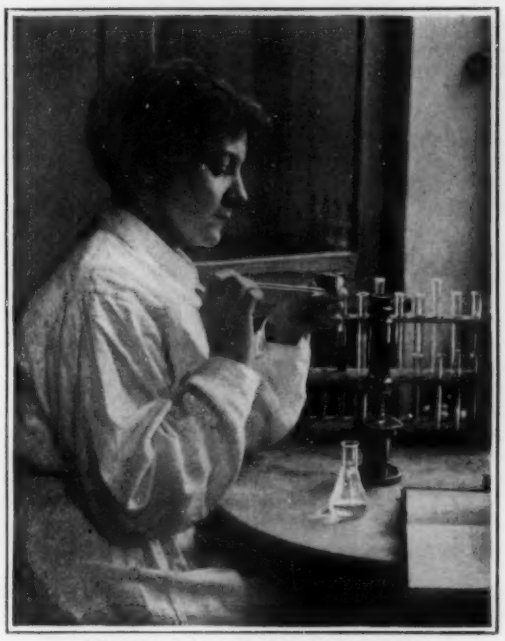
Once upon a time, a girl wishing to become a chemist, invariably had to go through a full university course leading to the doctor's degree. While this is still regarded as the proper procedure for those desirous of engaging in strictly scientific work and the synthesis of new compounds, the great mass of women-chemists, those intending to do analytical work may be content with the instruction, practical and theoretical, which a chemical school, in the course of a year, is able to impart. Such schools, specially intended for women, have sprung up during the last few years, in Berlin and some other German cities.

What first strikes the visitor on entering is an imposing array of retorts, test-tubes, stills and blowers; every pupil has her own working place which she must keep in order. The cleaning of glass vessels, crucibles, etc., demands the most scrupulous care; and each piece should always be in its proper place. Flowing water is always at the worker's disposal, and fire-extinguishers are provided, wherever convenient.

During the first three months of instruction, pupils are mainly engaged in filling up the gaps in their scientific knowledge, especially as regards the common operations of arithmetic. At the same time, they become acquainted with logarithmic reckoning and such elementary practical manipulations as filtering, separating, weighing, etc. Having thus been duly prepared, at the beginning of the second quarter, they are initiated into the secrets of chemical analysis—qualitative at first, learning to ascertain of what elements a given salt or alloy is composed. Through constant exercises the pupils become more and more closely acquainted with the mutual relations and effects of chemical elements.

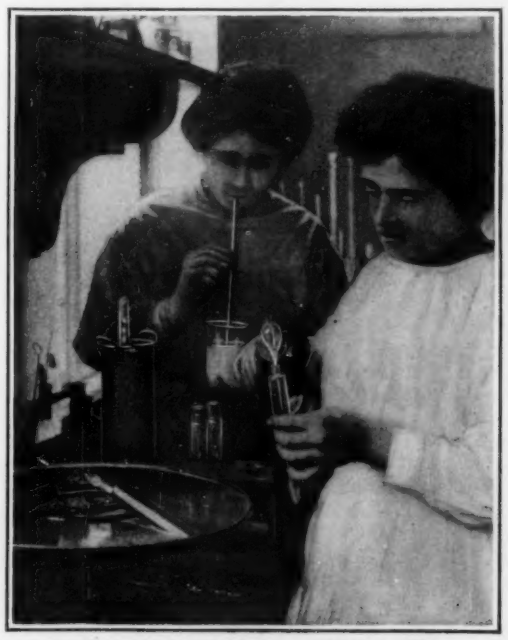
With the beginning of the third quarter, pupils are taught the operation of the special apparatus destined for the most important researches of practical chemistry. Thus, in order to ascertain the efficiency of a given coal, the woman-chemist uses a combustion oven where the coal combines with oxygen, to form carbonic acid; this can be caught up and weighed, allowing the carbon contents of the coal to be determined. In order to find out the percentage content of a sugar solution, she makes use of a polarization apparatus, where light waves are assigned strictly limited directions, in accordance with the actual concentration of the solution. These and many other operations involve the use of much fragile apparatus, for the handling of which, a woman's soft hand seems to be eminently fitted.

In the fourth quarter, pupils finally undertake the most difficult tasks of industrial chemistry, the testing of foodstuffs, specially important in time of war. In order, for instance, to ascertain whether a given sample of wine contains the proper percentage of alcohol, they distil the



Microscopic test of water for bacteria

sample, minus its solid ingredients—that is, the mere mixture of water and alcohol—into a slender glass still. After then determining the specific weight of the distillate, the alcohol contents are found from a table. Again, the percentage of fat in cocoa and other substances is



Determining the per cent of fat in milk

determined by extraction with ether in an ingeniously devised glass apparatus. Theoretical lectures on physics and general as well as analytical chemistry are, of course, given, side by side with these practical exercises, so that pupils may acquire a perfect understanding of the operations they are taught to perform.

By the very nature of their profession, women-chemists are effectually guarded against overwork, there being often nothing else to do for hours but watch the apparatus. Since there are no explosives in the laboratories of analytical chemistry, this branch of the profession cannot be said to involve actual danger to those embracing it.

A Collection of New York Sub-Surface Data Which Helps the Contractor

ONE of the greatest of first aids to investors in real estate, architects, contractors, and builders is a knowledge of the character of soil or rock underlying property that is to be improved. Usually a contractor either spends a considerable sum of money, sometimes running into the thousands, to obtain borings and thus secure definite information of the probable cost of work; or he goes ahead on speculation taking chances, which often prove very expensive in the end. Many a contractor has, in the past, lost his all trying to rest a building on a safe foundation in impossible places, such as the old Sun-Fish Pond which bankrupted the builder of the structure at Fourth Avenue and 32d Street; the Collect Pond, which caused enormous extra expense in the erection of the Municipal Building; the soft mud a few feet below the surface, which caused great loss to the contractor for the foundations of the Liberty Tower building; the quicksand where the Underwood building stands, and a host of other examples of mistakes made in different parts of the city.

Until a few years ago no records were kept of the borings made by contractors or companies, except on occasions. The results of the great amount of work and the thousands of dollars spent in this way were rarely preserved as information for those owning adjacent property. In 1911 at a discussion before the Municipal Engineers of the City of New York it was suggested that the Society could perform a valuable service to the city by aiding in the collection and permanent preservation of all boring samples, properly labelled and catalogued, and two years later the money for the purpose was appropriated by the Board of Estimate, with the understanding that the work should be performed under the direction of its chief engineer, Nelson P. Lewis, and Charles P. Berkey, Professor of Geology in Columbia University, aided by James V. Sanborn, of the Board of Water Supply; and their assistants began the work of collecting the borings which had been made in city and private enterprises, and laying plans to obtain the results of all future borings, excavations, etc., in the city.

Borings and specimens as far as obtainable are now fairly well classified, and within a short time the collection will be ready for use, and will be placed on permanent exhibition in the Municipal Building. In the meantime the collection is at Columbia University and is practically ready for easy reference. Maps have been made showing, as far as is known, the contour and cross-sections of the sub-surface of the city. One big map shows the whole city, and it is supplemented by smaller sectional maps with references to books showing particulars of the known places, with specimen borings and soil. Of course nothing like the whole city has been mapped, but contractors will be able to arrive at a fairly accurate idea of what is to be met within at least 100 yards of known conditions; and every excavation and boring made in the future sent to the engineers in charge will be put in its proper place, so that in the course of time the collection should furnish exact information to all who are concerned with the sub-surface of New York city. It is believed that this will make one of the most useful collections ever prepared by the city.

The delicate laboratory scales

Testing cocoa for fat content

Strategic Moves of the War—March 29th, 1917

By Our Military Expert

THE western front continues to hold the stage in the eyes of military critics for it is only here that a clear view of strategy on a large scale can be studied and conclusions drawn. Recent considerations on the German retreat had left in doubt the line upon which that withdrawal would stop. Opinion in general had settled upon that from Arras through Cambrai, St. Quentin, La Fère, Soissons or better Laon, and on to Vailly or Rheims; this was known as the Hindenburg line, though no good reason has been assigned for this particular name for the positions, as there is nothing to show definitely that Hindenburg would make a stop there.

But, if such lines have been selected, they are already gravely threatened for the French have reached the heights on the west bank of the Oise overlooking the valley to the north of La Fère; some of the advanced forts defending that town have been taken. The Germans are strenuously defending the plateau extending from St. Quentin to the Oise, but are being steadily forced back. The English have taken Roisel, an important railroad junction seven miles east of Peronne on the line from St. Quentin to Cambrai and are still moving forward.

A casual examination will show the results of these successes The Germans are largely dependent upon the railroads behind their lines for their communications and supplies. By the capture of Roisel the direct road from St. Quentin to Cambrai has been cut and railroad communication can be obtained only through Le Cateau and branch lines such as via Solesmes or one shorter line south; this is a most roundabout route of communication and even that is threatened if the Scheldt is crossed and Le Catelet taken. As Tergnier, the railroad junction, is already in French hands and as La Fère is practically commanded by French guns, rail communication between the two wings can be only through Versigny or Laon. Crecy-sur-Somme and Ribemont, Guise, Le Cateau. Everything points now to a break in the German lines at Roisel and Vermand, in which case St. Quentin must fall—also a break at La Fère, after which the forest and heights of St. Gobain would be outflanked. After this, the new German line would, perhaps, be Cambrai, Le Cateau, Guise, Laon, Rheims; or more probably, as outlined in the last review Lille, Valenciennes, Hirson, Méziéres, Verdun.

Just at this writing the German plan seems to be threefold: to hold the plateaux around Cambrai, which would protect all lines leading into the valley of the Scheldt;-to hold the plateaux between Le Cateau and Guise, which would bar the roads to Maubeuge and the valley of the Sambre; and to hold the heights of St. Gobain and around Laon, the loss of which would threaten all German defenses in the Champagne and would undoubtedly cause a retreat to the line, Mézières-Verdun, with a good possibility of a break near Mézières. It certainly looks now as if there might soon be a general retirement from both France and Belgium, largely through Luxemburg; but the lines from Lens to the North Sea still are strongly held with no signs of weakening. Everything points to a severe struggle in the Cambrai-Laon line and then a defeat and withdrawal of the Germans.

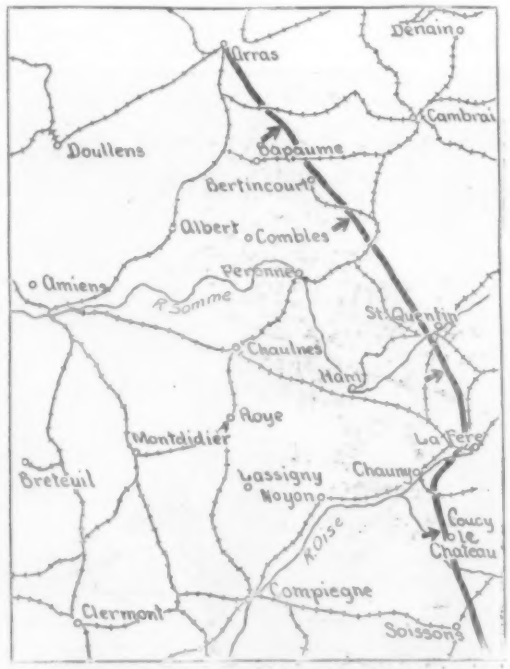
In the retreat so far the German forces appear to have been guilty of the most brutal outrages and destruction; while it is entirely within the laws of war to destroy roads, railroads and bridges, the senseless destruction of private property and the ruthless vandalism shown in laying waste the country behind them will make it hard for Germany when damages are being assessed around peace tables. This cold-blooded policy of destruction shocks the world and has aroused the French soldiers and French people to a policy of retaliation that bodes ill for Germany if she is defeated.

Despite bad weather and repairs and renewal of communications, both the English and French have made rapid advances on their respective fronts, particularly around St. Quentin, where the fighting has been most severe. This town is protected to the north by the Omignon River which is but little more than a creek. Running as it does, however, through a wide valley full of swamps and clusters of trees, it adds greatly to its own defensive value despite its small size. To the west and southwest in the direction of Monchy and Roupy the city is approached over a flat plain with few if any natural obstacles; of course the French can advance more rapidly but the plain ends in a sharp point at St. Quentin; at Savy to the southwest, the most defensive point, the Germans have built their main line of works.

The German right runs from the Omignon River at Vermand to St. Simon with its center at Savy. Here the French are making little progress, but on the left flank they have taken the high points of the plateaux of Essigny and Benay. It is certain that the Germans will do their best to recover this lost ground. Further south near the Gobain woods, the French have established themselves on the Soissons-St. Quentin highroad at Folembray and Coucy, which has been taken.

The strategic developments have now apparently taken place and the battle of St. Quentin is on. The situation is not a complicated one and can only be described as follows: countering the German plans the English troops are forcing the Germans back upon Cambrai and the valley of the Scheldt. At the same time the French are endeavoring, with every appearance of success, to break through the German lines at St. Quentin, capturing that town and obtaining a clear road up the valley of the Oise to Guide. Around Soissons the French, having taken Chivres, Vregny and Margival, are swinging their line about Missy as a pivot for the movable front, and are forcing their way slowly to the east and northeast, toward Craonne and Laon.

What will be the results of the combined Allied movements? A break in the German lines at any of the main defensive positions must lead to a hurried retirement; any break at or near Cambrai, or to the north of that town, will call for an immediate retreat of the Germans to the north into Belgium. There are two salients in the French line that are now very threatening for their opponents—the one that points straight at St. Quentin, the other overlooking La Fère to the north. A defeat for the Germans at either or both places would give the French easy access to the Oise valley and would at once call for an immediate withdrawal of the Germans all along the line from Soissons to Verdun, would free the Champagne and would require a retreat as far as the Meuse. If this should have to be done in a hurry, it would mean the loss or difficult extrication of the guns,



The Franco-British battle-line on March 29th

ammunition, and transportation now on that line. Of one point at least in all the strategic moves now in operation, one can be perfectly sure; the French commander is aiming for the Oise valley and beyond. A defeat for the Germans here would have many deciding influences upon the spring campaign on the western line this year.

All the tactical campaign on this part of the line so far has been much changed due to the rapid retreat of the Germans. German papers and even some military men in Germany have by fatuous reasoning converted this retreat into a German victory since the Allied plans could not be carried out—certainly a strange delusion. The Kaiser has even called it: "A new leaf of glory in the activities of my highest leadership." Where such praise should come in is not evident to one familiar with war operations. The retreat was wonderfully well executed in the face of a pursuing enemy, but it was made because the German commander knew he could no longer hold the lines.

The Entente Allies' plans were entirely disarranged, it is also agreed, but this was undoubtedly due to the fact that a successful advance was begun some weeks or months ahead of what was deemed possible by their commanders. As one paper has said, they are embarrassed only because they find themselves, in March, at a point which they had hoped to reach in July. Although the old line possessed disadvantages that the possible new one will lack, the problem of driving out the Germans remains for the Allies just the same. As a matter of strategy there is no change. The tactical employment of the Allies' various arms is now entirely different from trench warfare since the whole terrain of operations is also different.

The many problems of this great war make the difficulties of the Allies inconceivable when it is considered that all the questions of transportation and supplies have had to be solved over again as soon as the trenches were abandoned, and advance begun. The fact that a great battle could now be in progress so far to the front shows wonderful skill and generalship—and, what is almost equally important, it shows the master hands directing the regulation and transportation of food, ammunition and the thousand and one essentials for supplying the armies.

The shortening of the German line has no doubt released many men and guns that can now be utilized elsewhere; and possibly for that reason so much has been said of probable blows at some other points.

Dispatches from Russia tell of the massing of German troops along the north end of the eastern line with the object of driving at Petrograd. The nearest point of the present line is 300 miles from that city. The intervening country, especially around Riga, Mitau and along the Dwina River, is low level and of a marshy nature. If it is not at the present time frozen and snow-covered, it is certainly converted at this season, when the spring thaw begins, into almost a continuous lake from melting snow and ice, and this thaw is to-day reported as having commenced. Under such circumstances no military action of importance would be possible for some time on that part of the Russian front. It is hardly probable that such a move could be contemplated by the German commanders at this season, though some slight activities on the eastern front would indicate a beginning of military operations.

One serious drawback here is that the greater part of all of the eastern line is held by Austrian troops, who are regarded by the Germans as not very reliable fighters. Germany, herself, cannot well spare at the present time, enough troops of her own to give sufficient strength to so large a field of operations. With the new blood that is now at the helm of state affairs in Russia, made up of some of the ablest statesmen that country has ever produced, and with a new general staff that will have full control of the armies in the field, it is not seen that much is to be feared from any contemplated drive of so great an extent as that now discussed. If a drive is contemplated at the present time by the Central Allies it would seem most probable that it will be directed against Italy in the Trentino or along some other part of the Austrian front, where the coming of spring and the disappearance of snows will render possible active operations. Such seems to be the general opinion in Italy, where every preparation has been made to forestall it. Here, again, the Austrian troops are in the majority; and it remains to be seen what they can do under present unfavorable conditions. There can be but little doubt that Austria politically is now greatly disturbed and that the people there are beginning to ask what the war will bring to them. They are weary of it and of the suffering that it has brought upon them. If reports are to be believed all semblance of constitutional government has long since disappeared. With a population differing so much in temperament from the law-obeying, law-abiding Germans, it is a great question how long German influence and authority at the Austrian court and in the country will be allowed.

Summarizing the war on the European fronts, as it has now stood since the last review, nothing of importance has happened on any front other than the western; this condition has been due undoubtedly to the continued effect of the wintry weather and the consequent hindering of troop movements. On the western front the rapid advance of the first few days has slowed down as the Allies have approached the German lines in the latters' new positions.

From the sketch map it will be seen that the new front extends almost in a straight line from Arras to the vicinity of St. Quentin and the Oise River, along the heights of this river to and opposite La Fère and then south and southeast to Margival, north of Soissons, to Vailly, and to the Aisne River. The British are pushing forward to Cambrai and Le Catelet. The French are making every effort to reach the valley of the Oise, while to the south along the Aillette River the Germans are holding desperately to the plateau of the forest of St. Gobain and parts of the forest of Coucy. To the south and east of the railroad that runs in the valley from Soissons to Laon lies the plateau of Craonne, so famous in 1814 as the scene of a strong attack by Napoleon on the advancing Prussians. Upon the ability to hold these two plateaus will ultimately depend whether the retreat now in progress will stop at or near Laon on that part of the line, or whether as indicated heretofore it will go back to the line of the Meuse. With only the present

(*Concluded on page 357*)

The American Merchant Marine

Where It Will Stand Upon Return of Normal Times

By Robert Dollar

IN considering the shipping conditions of this country, we must not be carried away by the abnormal state of affairs now prevailing in the world of shipping, caused by the war. Any inexperienced person can run ships today, and make money—provided he can get ships to run. But after the war, only the experienced and competent will be able to continue in the business during the keen competition that will follow the greatest shipping boom the world has ever seen. The question asked on all sides is "Will the American ships be able to continue in foreign trade, in competition against more favored nations?" Unless our navigation laws and inspection regulations are materially changed, the answer to this is a most emphatic "No."

This article is not a political one, for the tendency to restrict and embarrass American ship owners, to make the operation of American ships in foreign trade a financial impossibility, is born of no political organization. Both parties have contributed impartially to the existing volume of legislation upon this sore subject. At the present time, owing to the fact that our laws force us to measure our ships larger than other nations do, we must pay in foreign countries more tonnage dues; pilotage, dry-docking and wharfage cost more for the same reason; and on this one head alone an American ship pays out each year $5,500 more than does its foreign competitor. We impose, in the inspection of our ships at our home ports, delays and requirements that no other nation duplicates, which create an additional annual expense of $3,000. We force our ships to carry extra men in the engine-room, at a charge of $8,736 each year which no foreign shipowner is asked to bear. And the wage scale paid the crew of the American ship puts her under a further handicap of $23,544 per annum, as compared with an English vessel.

Here we have a typical comparison which shows that the American owner pays out each year $40,780 more than his foreign competitor. And this is not an extreme case. If we take three steamers of about the same size and horse-power, we find that the American steamer "Algoa" costs $39,240 per year in wages; the British "Robert Dollar," $15,696; the Japanese "Asama Maru," $9,324. And we have compared with the British, not with the Japanese. These figures, incredible as they may seem, are taken from my own books; and while space will not permit me to go into a detailed justification, I can vouch for their accuracy.

At least so far as wages are concerned, this discrepancy could be modified, without asking American seamen to work at the foreign wage scale, and still without introducing the subsidy idea so repugnant to many of our legislators. The ship owner does not pay his men directly, but hands the money over to the Government Shipping Commissioner, and this official pays off all seamen. So it would be entirely feasible for the men to be carried on the ships payroll at foreign wages of, say, $30 per month, and, if American wages were $50, for the Commissioner to pay each American citizen of the crew, from special Government funds, the difference of $20. At the present time an official report of seamen employed upon American vessels shows that 8 per cent are citizens born, 17 per cent are naturalized, and 75 per cent are of foreign allegiance. The suggestion which I advance would soon remedy this; in a very short time our crews would become entirely American, bringing about a condition which Congress is supposed to have long been aiming at. And the great bugaboo of ship subsidy would not come before Congress, for it would be simply a payment to the men, putting them on an American wage scale in spite of the fact that the industry in which they are engaged cannot support that scale.

But aside from the direct financial inequality which our laws maintain between our ships and those of foreign registry, there are several small and vexatious restrictions, which admirably illustrate the fact that our Government has for many years maintained toward our shipping a policy of destruction rather than of construction. To be sure, if you will ask your Representative why handicaps are put upon our ships which no other nation puts upon its, he will tell you that he does not know. Perhaps it is as much a matter of inertia as anything. The Committees of Congress have been informed repeatedly and in minute detail of all the injustice and unreasonable exactions; but nothing is ever done to remedy the situation. The American owners do not claim any special privileges; they ask merely that they be put upon a footing of exact equality with foreign competitors. There is abundant American money ready to go into the business as soon as it is assured that reasonable profit can be made from operation of American ships; but of course, not till then will we have much of a merchant navy.

As an example of the petty and short-sighted legislative attitude I may mention the method of classification of American ships, prescribed by law. Ships must be designated as of less than 100 tons, or else as of 100 tons and over. This of course puts the 100-ton freighter, smaller than a respectable pleasure yacht, in the same category as the largest ocean liner. There should be classes for freighters of 100 to 500 tons, freighters of 500 tons and over, small passenger steamers, large passenger liners. If the classification were merely a paper one it would be only amusing; but it is one upon which charges, inspections, etc., are based, so it is more than just absurd. It works a very real hardship upon the small owner. We might as well make the same traffic regulations for a two-horse dray and a through freight and a limited passenger train. Colonel Goethals, in a public address the other day, stated that two sister ships, exact duplicates, went through the Panama Canal. One was under American registry, the other British; and each was measured according to the rules of her registry. The American paid $500 more in Canal tolls than the British, because of the discrepancy in these rules.

Then again, every nation in the world pays its passenger steamers a fair compensation for carrying the mails —except the United States. Nor is there a nation in the world with a colony of the importance of the Philippines that has not a direct, subsidized if necessary, steamship line running there to carry the mails. We have been depending upon the generosity of Japan to carry our Philippine mails, because this would save a few dollars for our Government, so well known for its policies of no economy where economy would mean something worth while. We have an unofficial announcement that all mails carried by Japanese vessels are to be censored. Why not? We should present an elegant spectacle indeed, with our official Philippine mail opened and read by Japanese censors.

The clamor for an American merchant marine is not an idle vaporing. This country has reached a point where it must have foreign trade, and plenty of it. There was a time, when we were developing our country, when we did not require foreign trade to any great extent. But that time is past. Our Secretary of Commerce tells us that with all our factories running full time, we can manufacture in six months all that we require for a year's domestic consumption. Therefore we must choose between exporting half our manufactured products, or running our industries half time. In fact, there is not a single one of us, however indifferent he may feel toward foreign trade, who would not find, on close analysis, that he really was interested. The farmer produces more than he can sell locally; throughout the country, he produces more of many crops than America can eat. The manufacturer is in the same boat. So for farmer and factory worker alike it is essential that we export surplus production to foreign shores. The financial world is interested in underwriting this business; the transportation world, in making the movement possible.

It is not merely a question of whether we shall carry on a definite volume of foreign trade in our own ships or in ships belonging to somebody else. Even from this point of view there is much to say for an American merchant marine; but there is a much larger point of view. Every ship that takes a cargo out from its home port must either seek a return cargo or come home in ballast. The latter procedure, of course, involves a double charge against the cargo taken out; so every effort is made to find some sort of cargo to bring back. There is no more efficient trading scout than a fleet of boats in foreign ports, looking for something to bring home. Trade is, as nearly as possible, an exchange of commodities; and here we should have a tremendous impulse toward stimulating trade.

We were to have derived great benefit from the Panama Canal. Among other things, the Canal Act permitted the importation of ships into this country free of duty. A praiseworthy effort toward a merchant marine; but not a single ship took advantage of the munificent offer, simply because our laws made it financially impracticable to operate ships under American registry. At the start of the war came the ""Emergency Act," a great benefit, and hailed by ship owners as the initiation of a more reasonable policy. In this expectation they were doomed to disappointment; it was followed by the vicious "La Follette Seamen's Bill," which, in normal times, would have driven the last nail in the coffin of the American Merchant Marine. That it did not do so on the spot is of course only because of the wholly abnormal conditions of the past two years, in which anything that will float can make a handsome profit, regardless of operating expenses.

As an indication of what is to be expected with a return to normal times, I may cite the case of the old Pacific Mail Company. They did not pay a dividend for thirteen years; and at the expiration of this period, the "Seamen's Act" proposed to help them out of their difficulties by saddling upon them an additional operating expense of $600,000 per annum. This prospect put them completely out of business, necessitating the sale of the ships, and the abandonment of the Pacific to the Japanese lines. Before the war 26 per cent of our Pacific trade was carried in American bottoms, 26 per cent in Japanese, 29 per cent in British, the rest in German and a few scattering ships from other nations. In May 1916, our own ships were carrying 2 per cent of this total, Japanese vessels 51 per cent, British 37 per cent, Dutch 37 per cent. At present 79 per cent of our exports from our Pacific ports, and 73 per cent of our imports into them, are transported by the Mikado's fleet.

The new Pacific Mail had an experience which illustrates the working out of the benevolent "Seamen's Act." They employed on a certain ship a full American crew. The Act compels the Captain to pay the men, at every port, half the wages they have earned up to that date. The first port being Honolulu, the men went ashore with their wages, and forgot to come back, delaying the ship a whole day. At Yokohama the performance was repeated, only this time the ship had to sail without the full crew, paying the fares of the missing members by rail to Kobe. As a last straw, during a reception to some Japanese merchants, held aboard the ship, a free-for-all fight took place, attributed to the stimulating effect of Japanese whiskey upon American huskies. This so exasperated the company that they fired the crew on the spot, and hired Chinese in their places; but in spite of the ample grounds for discharge which these men had given, the company, under the law, had to pay their passage in idleness to an American port. This is a very fair sample of the way laws work out when passed by well meaning persons who have no slightest idea of the true state of affairs in the field to which their legislation is to apply.

Then we have the new Shipping Board, to which shipping men pinned a deal of faith, in view of the thorough competence of the chairman-presumptive, and the expectation that the Board would be wholly non-political. Now it turns out that the "non" is to be so thoroughly eliminated that this gentleman refuses to serve. While it would of course be unfair to criticise the new Board, it is fair to say that the ship owners of the country put little faith in it. We must judge by results; but it is clear that what is needed is not so much a new body, as a wholly new attitude toward the men who are expected to restore America to her old place upon the seas.

The Current Supplement

THE successes of the British forces in Macedonia call attention to the Baghdad Railway, that important line of communication that was intended to secure to Germany the control of commerce from the East. An article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT No. 2153, for April 7th, gives the history of the inception of this line and facts relating to its importance and to the progress that has been made in construction as far as is now known. The article is accompanied by an illustration and a map showing the line and its proposed connections. An article on *Relativity and Gravitation* gives a summary of a discussion of recent attempts to include gravitational phenomina within the scope of a generalized relativity theory. An article on *The Metric System* calls attention to its importance as an international language of weights and measures. *The Fixation of Nitrogen* gives some notes on new and cheaper methods for obtaining this necessary material, *An Eruption of Lassen Peak* contains much authoritative information relating to our only American volcano, and is profusely illustrated. *Progressive Oxidation of Cold-Storage Butter* is an investigation of the causes of the development of undesirable flavors. The article on *The Value of High-Level Meteorological Data* is concluded in this issue. An article on *Phosphorescence* deals with the phototropy of inorganic systems. Other articles are *Soap Bubbles of long Duration*, *Cast Iron Growth* and *Germany's Supply of Manganese*.

Metabolism of Cold-blooded Animals

SOME pioneer studies on the metabolism of cold-blooded animals especially serpents and tortoises, are in progress at the New York Zoological Park. Respiration chambers of various sizes have been constructed. Animals of this class have an extremely low metabolism; hence the largest specimens available have been used in the experiments. A chamber was built large enough to contain a Galapagos tortoise weighing 290 pounds. Later a recessed cover was designed, which considerably reduced the volume of the chamber and permitted its use for a 16½-foot Indian python and a 7½-foot alligator.

Gun Versus Armor

Will Long-Range, Big-Gun Attack Call for a Redistribution of Armor?

By J. Bernard Walker

THE excessive ranges at which naval engagements have been fought has been one of the surprises of the present war. For several years prior to 1914, target practice was carried on in our own navy at ranges of from 9,000 to 10,000 yards, and, so far as we knew, 10,000 yards was accepted by the foreign navies as the maximum at which it was necessary to train the gun crews for the actual ordeal of battle.

Early in the war, however, it was realized that fighting was going to be done at the maximum ranges at which the ship having the speed-gage, could land effectively on the enemy. Thus, von Spee, although he carried nothing heavier than an 8.2-inch gun, elected to fight Cradock at 12,000 yards; and, later, Sturdee, having the speed-gage of von Spee and the heavier guns, chose to stay off at a range of from 15,000 to 16,000 yards and take his time in picking off the German ships. Beatty, in the Dogger Bank fight, landed on the Germans at 17,000 yards, and later, in the great Jutland fight, some of Beatty's ships opened up at 20,000 yards, which, be it noted, is just double the maximum battle-range at which naval ships were practising when the war began.

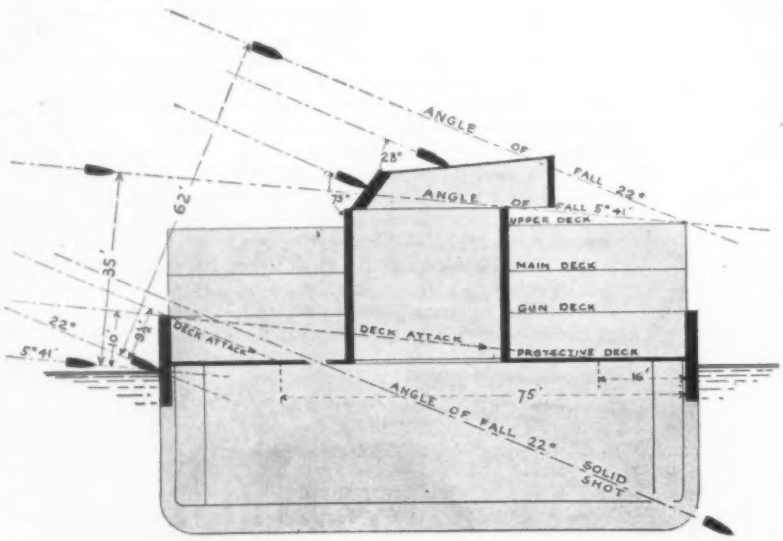
Because of the vast amount of valuable data gathered by the combatants during many a hotly-contested sea-fight, we may be sure that the designs for new ships are based, not upon theory, but upon well established facts. It is probable also, that the ships, guns and methods of armoring which have been adopted in the new construction of the British and German navies, will determine the trend of naval development for many years to come. Naturally it is difficult to obtain well authenticated information as to what the British are doing, but such as we have received goes to prove that the heavy, long-range gun will be the determining factor in the design of future battleships, and that its influence will be felt principally in the direction of increasing speed and mobility at the cost of armor. In 1914 the heaviest guns in any navy were the 15-inch guns on the "Queen Elizabeth" class, and they were mounted on ships which had an excess of four or five knots speed over contemporary battleships. Apparently the British, in spite of the fact that increasing the caliber so greatly limits the number of guns that can be carried, have gone up to an 18-inch gun, a piece whose shells must weigh not less than 3,000 pounds and whose weight must approximate 150 tons. We understand that these enormous pieces have been mounted on ships that are lightly armored, but have a speed greatly in excess of anything hitherto attempted in ships carrying guns of the largest caliber.

Herein then, we find a suggestion that the first-line fighting ships of the future may be lightly armored vessels, carrying guns of great range and power, and steaming at battle-cruiser speed. In other words, it is quite possible that the slow-moving, heavily-armored battleship, as we know it to-day, may give place to a type of battle-cruiser in which armor will be practically eliminated in favor of speed and gun-power. Speed, it should be noted, is the logical concomitant of the big gun; for an excess of speed, will enable the fast ship to select the range at which its super-guns (if we may coin a term) will be able to land upon the enemy without his being able to make an adequate reply.

The above considerations make it reasonable to expect that the naval fights of the future will take place at ranges even greater than those attempted in the present war. If naval artillery goes up to calibers of 18 or even 20 inches, it is certain that the ranges will go up proportionately; and it is quite conceivable that future engagements will be fought at ranges of from 20,000 to 25,000 yards, provided, of course, that vision is sufficiently good to permit of this.

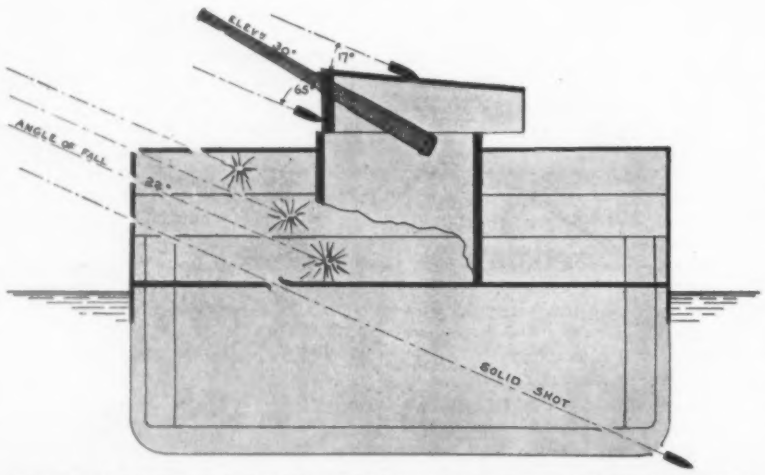
In the two accompanying sketches we have attempted to show how great a modifying effect the steeper angle of fall of the shell at these ranges must necessarily have upon the distribution of armor in war ships designed for that kind of fighting. The upper sketch shows, approximately, the present distribution of armor in battleships. In the lower sketch we show the modifications, which it seems to us should be made to meet what practically amounts to a modified high-angle fire.

The armor plan of most existing battleships is drawn up to meet the conditions of attack at fighting ranges of from 8,000 to 10,000 yards. The vitals of the ship are protected by a heavy water-line belt associated with a protective deck, three inches or so in thickness. In some of the later ships there are two protective decks, one in the usual position just above the water-line and the other at the gun deck at the level of the top of the belt. In the latter case the protective deck is generally about two inches and the gun deck about one inch in thickness. The ammunition hoists and the barbette and turret mechanism are protected by thick vertical armor, and the turret by a heavy sloping port-plate associated with lighter armor on the side walls and at the rear, and light armor 3 to 5 inches thickness on the roof.



Angle of fall, 50-cal. 14-in. gun, at 10,000 yards is 5° 41'. At 22,500 yards, angle of fall is 22°. Heavy belt armor covers the protective deck at the former range, but leaves it exposed at the extreme ranges.

Present method of armor protection, designed to resist big-gun attack at 10,000 yards



Redistribution of armor to meet the plunging fire due to extreme ranges. The complete envelope of light armor is designed to burst the shells before they reach the protective deck.

Proposed armor plan to meet plunging fire at 20,000 to 25,000 yards range

Now at 10,000 yards a shell from one of our 50-caliber, 14-inch guns, would strike the enemy on an angle of 5 degrees, 41 minutes and it will be seen that the vitals of the ship would be well protected. A shell which just cleared the top of the armor belt, if it did not explode would reach only the far side of the protective deck. In our latest ships it has been thought best not to arm the topsides above the belt, but rather to concentrate the weight in belt, protective deck, barbettes, etc. It will be noticed from our diagram that at 10,000 yards the belt armor covers ten feet out of the thirty-five feet of projected area of the ship which is exposed to shell-fire.

Now at 20,000 yards the angle of fall of the 14-inch shell is 18 degrees and at 25,000 yards it is 26 degrees, 30 minutes the mean of which would be about 22 degrees. Plotting this upon our diagram, we find that the heavy side armor protects less than one-sixth of the projected area of the ship, and that instead of a few feet of the protective deck being exposed to plunging shell attack, 75 feet are thus exposed. This means that under long-range attack not only are the chances of hitting the ship nearly doubled, but over three-fourths of the protective deck is subjected to plunging fire. Manifestly, the present method of distributing the armor was not designed to meet a modified high-angle fire, and the question arises as to whether our present methods of armor distribution should not be altered to meet the new conditions.

We present in our lower sketch a suggested rearrangement of the armor. Taking it for granted that the vitals of the ship, (motive power, steering gear, magazine, etc.), should have the first call upon the armor, it would seem that efforts should be directed to bursting the high-explosive shells as far above the protective deck as possible, on the probability that where an unexploded shell might go through, its fragments would not. It becomes a pertinent consideration whether it is not better to leave the protective deck at its present thickness of about 2 inches; armor the upper deck in preference to the gun-deck; and distribute the heavy belt in the form of lighter armor extending over the whole side of the ship. This complete armoring of the above-water portion of the ship would go far to insure the bursting of the shells as soon as they entered. The probability is that the shock of penetrating this outer armor would cause a shell to burst above the main deck, and in any case there would be the additional shock of passing through the main and gun-decks to cause fragmentation before the protective deck was reached.

It seems to us that plunging fire should also bring about a modification of the turret armor. The sloping of the port plate of existing turrets was adopted to present an inclined surface to the attack of shells which arrived at an angle of between 5 and 7 degrees. As our diagram shows, a return to a vertical face of greater height would present a less favorable angle of attack (65 degrees in place of 75) and the rearward slope of the roof, which in any case should be thickened, would make penetration through the roof very unlikely. It is known that the loss of one at least, and possibly two, of the British battle-cruisers in the Jutland fight, was due to the flash of an exploding shell which came through the roof reaching the magazines through open ammunition hoists.

It will be understood that the above suggestions are based upon recognition of the fact that no thickness of armor will serve to keep out shells of 16- and 18-inch caliber, except at very oblique angles of impact; and that effort should be directed therefore to bursting them as near to the outside of the ship as possible.

Finally, our diagram shows that a shell which did not burst or a solid shot, falling at 22 degrees and missing the top edge of the belt armor, would pass through the protective deck and out through the bottom of the ship. This suggests the thought that, in long-range engagements we may see a partial return to the use of non-explosive projectiles.

The Manufacture of a 16-Inch Gun

IN our recent Naval Number we gave illustrations of the new 16-inch gun as it will look when completed, and also described its great weight, power and the extreme range to which it can be theoretically fired. There has not been very much change in the methods of big gun construction for over a decade. The improvements have been in the way of refinements of the details of manufacture. Gun steel, as it is called, is a special steel, whose composition and methods of manufacture are designed to provide a steel of high tensile strength with a great hardness. The finished gun consists of an inner tube, over which successive hoops are shrunk until the proper strength is secured to withstand the bursting stresses of the powder charge. The tube and hoops are forged on a mandrel under a hydraulic press. The various parts of the gun are bored and turned, annealed, and tempered, and the gun is finally assembled by shrinking the hoops on the tube. Our front cover illustration shows the huge plant for the oil tempering. The tube, which in the case of the 16-inch gun, is

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The Heavens In April, 1917

Star Light and the Sensitiveness of the Human Eye

By Henry Norris Russell, Ph.D.

As we look out into the clear skies of a moonless night, we gain the impression of a multitude of stars, scattered all over the vault of heaven. Yet if we select any specified region of the sky, and try to count all the stars that we can see within it, we will soon find that our list comes to an end; and if, bit by bit, we should extend our count to cover the whole of the visible dome of the heavens, we would find that, all in all, the number of stars visible to even a keen eye on an ordinary fine night does not materially exceed two thousand.

This is actually rather a small number—not nearly as great, for example, as the number of separate openings in the wire netting of a screen large enough to fill even the smallest window. Yet the holes in the screen do not in the least produce in us the impression of countlessness while the stars of heaven, from remote antiquity, have been a classical illustration of innumerable abundance. Why should this be?

A part of the explanation is probably that, when objects are arranged in an orderly fashion, in rows or columns, like the openings of the screen, it is far easier, not only to count them—with the aid of that great labor-saving invention, the multiplication table—but to convince oneself at a glance that there are only a finite number of rows, and of objects in each row, and that, therefore, the total number of objects, though large, must have a limit. But when objects, like the stars, are scattered irregularly over a region too large for us to see all at once, no such process of unconscious judgment can become operative, and the impression produced by their actual abundance is much more powerful.

More important than this, however, is probably the fact that, for every star that we can see clearly, there are two or three others so faint that we can see them only by glimpses—thus suggesting what the telescope shows to be entirely true, that, if our eyes were but more sensitive, we would see very many more stars than we can see now. This impression is enhanced because we can see such faint stars only by averted vision. The position of the retina of the eye which we use normally in looking fixedly at any object, and which alone is sensitive to the discrimination of the finest details of outline and color, is relatively small, and, when we are "looking at" anything, we instinctively move our eyes so that the image of the object in question falls upon this region of the retina. The outer "peripheral" regions of the retina are more sensitive to very faint light than the central portion. Consequently we may see a star when its image falls on some part of this region—that is, when we are looking at something else—and when we turn our eye to look at the star we have glimpsed, behold! its image now falls upon the less sensitive central region of the retina, and we can see it no longer! Yet when we glance away again, we may once more get a glimpse of the elusive speck, and our puzzled consciousness may find it hard to decide whether the star is really there or not. Of course this fact is thoroughly familiar to scientific observers, who habitually search for a very faint object by "averted vision,"—a process which after a little training becomes a simple thing.

How faint is the faintest star that can be seen with certainty by the unaided eye? Of course the answer depends somewhat upon whose eyes are in question: some few men have exceptionally keen vision, and the eyes of many are relatively dull. But, for the normal healthy eye, the limit is pretty well defined. Under ordinary conditions—that is, for an observer near sea level on a thoroughly clear night—the faintest stars visible without optical aid are of just about the sixth magnitude.

This means that their brightness (measured of course with the aid of telescopes in which they are easily visible), is just $\frac{1}{100}$ of that of a standard first magnitude star, such as Aldebaran. It may be more interesting to compare it with that of the more familiar terrestrial sources of light. From the measures of several observers, it appears that a standard candle, or better, an electric lamp of just one candle-power, would appear as bright as Aldebaran if removed to a distance of 3,600 feet, or a little over two thirds of a mile. To equal the stars which are barely visible to the eye, the candle would have to be put ten times as far away, or at a distance of fully six and one half miles.

This statement, however, must be accepted with one important proviso, namely, that the *color* of the light of our standard lamp should be substantially the same as that of sunlight—that is, of a strongly bluish-white, compared with ordinary terrestrial sources of light, which, though incandescent, are at a far lower temperature than the sun or most of the stars. Such a light source can now easily be produced by letting an incandescent lamp shine through the "daylight glass" which, by cutting out the excess of red and yellow rays, tempers the quality of the light to the desired character. A lamp which, shining through a bit of such glass, gave a light of one candle-power, would doubtless actually be visible on a clear night at a distance of approximately six miles.

A common incandescent lamp which, when near by, appeared as bright as the other, would become quite invisible at a much smaller distance—probably not more than three or four miles. The reason for this is that, as we pass from strong light to faint, the sensitiveness of our eyes to red light decreases more rapidly than their sensitiveness to blue light, so that the relatively red light of the unscreened lamp would appear to fade more rapidly than that of the one shining through blue glass, even though their actual intensities were reduced to exactly the same extent. This peculiar behavior of the eye—known as the Purkinje phenomenon from the name of its discoverer—greatly complicates all measurements of the brightness of faint objects and notably that of the stars.

But the whole story regarding the limits of perception by the normal eye has not yet been told. The stars, even on the clearest night, are not by any means seen upon a dark background. Most of the light in the sky, even at a station far removed from all sources of artificial illumination, comes from the multitude of telescopic stars, too faint for the eye to see, but so numerous that, taken all together, they send us far more light than those which we can discern individually. There is usually—perhaps always—present in addition, some light originating on the earth's atmosphere, which, from the presence in its spectrum of the bright line characteristic of the aurora, betrays its place of origin.

When we are out in the open on a clear starry night, we hardly realize how strong this illumination is—it is quite enough to find one's way by across open country, if there are no concealed traps for unwary feet. But when once we get a glimpse of the sky through an opening between thick trees, we see at once that, even on a brilliant, moonless night, when the sky, as we look sharp at it, seems like black velvet powdered over with sparkling points, the background is really anything but dark.

Now, there can be no doubt that the light—one might almost say the glare—of this general illumination of the sky drowns out the fainter stars.

To give an illustration from common experience, whenever we see a star through a little gap in the leafage of a tree, upon the dark background, it looks much brighter than ordinarily—not because it has changed at all, but on account of the greater contrast with the blackness surrounding it.

Very conclusive evidence of the existence, and the surprisingly great magnitude of this effect was obtained some years ago at the Lick Observatory by Professor H. D. Curtis. A large black screen pierced by a small hole, was attached to the end of a telescope remote from the observer, while a smaller screen near the eye, was so placed that the line of sight through a hole in it and the hole in the larger screen, a dozen feet away, was parallel to the axis of the telescope itself, so that a star visible at the center of the telescopic field of view would also be visible through the two holes, upon the black background of the large screen. With this simple apparatus observations were made upon a number of faint stars—one man watching with the naked eye through the holes to see whether the star came into view as the telescope was slowly moved, while another, at the eyepiece, checked up the observation by determining whether the star was really on the line of sight when the first observer thought he saw it. In this way it was found that stars of the seventh magnitude, and even fainter, were easily seen when displayed upon a really dark background, and the faintest objects, visible with difficulty, were actually below the eighth magnitude—that is, at least five times fainter than the faintest stars which could be detected by direct vision upon the same night, even in the very clear atmosphere of Mount Hamilton. The actual limit of visibility, upon a perfectly black background, and for an eye fully rested in the dark, probably corresponds to the brightness of a star of magnitude 8.5—which is ten times fainter than the limit usually assigned for observation upon the background of the sky, and corresponds to the light of a single candle (of proper color) at a distance of no less than *twenty miles*.

That the human eye can actually detect such exceedingly faint illumination is confirmed by some experiments by the present writer upon the visibility of little disks of white cardboard, mounted on a black background, and observed in a dark room by the light of a single star (usually Sirius) shining through a small opening in a shutter.

Once more it is necessary to remark that a one-candle-power lamp, even of the ideal color, would doubtless become invisible at a distance much less than twenty miles, even if all else was perfectly dark, because of the absorption of its light in traversing this great thickness of air, which is fully four times as great as the amount actually traversed by a ray coming down from a star nearly overhead. Measurements show that, even in the clearest weather, 20 per cent of the light of a star in the Zenith is lost in coming through our atmosphere. At the same rate, an object at sea level 20 miles away would appear only 40 per cent as bright as it would do if the air was not in the way and, if the air was the least bit hazy its brightness could be cut down far more.

At mountain stations, where one is above the greater part of the lower, dust-laden layers of the atmosphere, fainter stars are visible than at sea-level. Some recent observations at Mount Wilson by Van der Bilt show that the limit of unaided vision there, without even the aid of screens to shut off the light of the sky, is at about the seventh magnitude—that is, the faintest stars that can be seen on the mountain are two and a half times as faint as any that can be seen at sea-level.

Only a small portion of this remarkable increase can be due to an actual difference in the transparency of the atmosphere; but the rest may easily be accounted for, since it is well known that the diffused light of the sky is far less at a station like Mount Wilson than at sea level, and this would afford a darker background upon which to observe the stars.

At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.

At 9½ o'clock: April 30.

At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 22.

NIGHT SKY: APRIL AND MAY

The Heavens

Though most of us are not so fortunate as to see the stars through the thin clear air of a mountain observatory, we can all acquaint ourselves at least with the brighter stars, such as those shown upon our map. Our survey of the sky may well begin in the south, where we will see a bright star, fairly high up and a little east of

(Concluded on page 355)

Loading the coal cutter upon its truck to move it to another location. The cutter bar projects toward the foreground

Making the first cut at the lower corner of a heading. The long cutter bar is concealed by the body of the machine

Machines for Mining Coal

Reducing the Hazards of Hand Mining and Improving the Product

IMPROVED machinery for obtaining greater efficiency is not confined to industrial plants or operations above ground. It has invaded the mining field, where one of its important applications is a modern coal-cutting machine for mining bituminous coal. The use of this machinery is claimed to insure rapid development of the coal fields in which it is employed, to reduce the cost of operations, to eliminate the dangerous practice of the older methods of hand mining, and at the same time to improve the quality of the product.

The illustrations show a modern coal cutting machine and how it operates as well as some of the results. It has a long tongue-like protrusion or bar, called the cutter bar, on which cutting knives revolve or travel. The cutter bar is attached to the lower side of the machine and extends several feet to the front. The entire machine or cutter weighs about 5,000 pounds, and with the truck on which it is moved from place to place and complete equipment it weighs 7,000 pounds. It can, however, be quickly and accurately handled by two men.

In actual operation the machine is moved under its own power to a mining room or chamber in a mine and, after being unloaded from its truck, is placed in the position shown in the second cut above. This shows the cutter bar making the initial or sumping cut under the coal at one corner of a room. This cut is always at the level of the ground or floor. A chain, held in position by jacks, feeds the machine in its various operations. A sumping bar or pan holds the machine in correct alinement and protects the operators engaged in making the initial cut.

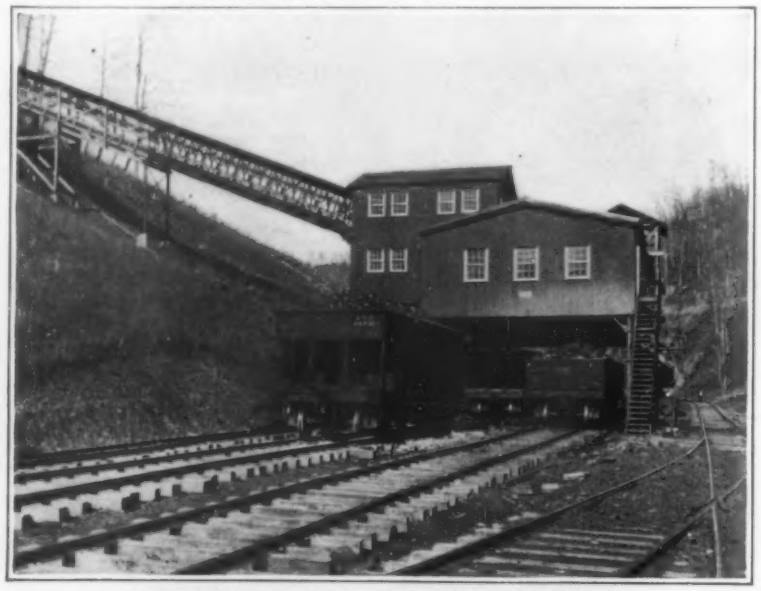
After such a cut has been made sufficiently deep the machine is withdrawn from it and loaded onto its truck and taken to another room or heading. The coal having been thus undercut the full depth across the width of a working place averaging 30 feet wide, two holes are drilled near the ribs of this working place. A light shot of powder, exploded in these holes, then separates the coal from the mass and turns it over ready for loading.

The safety first principle is claimed as one of the great advantages of this method. The older practice of "shooting from the solid" involves danger from flying pieces and is less efficient. The improved quality of the product from "undercutting and shooting" is emphasized.

After the process as described has been carried out, the coal is loaded into pit cars. The miner hangs a metal check, containing his number on it, in each car. This check is removed at the dump house by the weighman who credits the tonnage on the particular car to the miner entitled to it. These cars are then brought out of the mine by an electric locomotive, which takes them to a common dumping house. The same locomotive then takes the cars back to the miner.

From the dump house a conveyor takes the coal *en masse* to a tipple house, where a system of chutes and screens separates it into the various sizes. We show the interior of the tipple house and the arrangement of conveyors and loading booms for various grades of coal, as well as the shaker screens for grading the various sizes. Still another view of this stage of the operation shows the shaker screens located in the tipple house, where the coal is spread upon the screens from the retarding conveyor. The screen is graduated so that the coal in passing over it is separated into groups according to its size. Extra screens for grading special sizes of coal are visible at the left of the illustration.

This system of mining and handling the coal produces three grades of coal—block coal, round coal, and nut



Loading the coal into the cars from the tipple house

Tipple house, showing arrangement of conveyors, loader booms and shaker screens

The shaker screens over which the coal passes to be graded according to size

and slack coal. Before leaving the screens and collectors at the tipple house, all coal is sprayed with water to clean it. One of the cuts shows the tipple house with the coal conveyor leading from the dump house and also the track arrangement. The three tracks enable the loading of the three grades of coal at once, so that no matter what comes from the mines, it is taken care of as fast as it is delivered.

The undercutting machine is claimed to produce more large coal and less fine or small coal than the older system of blasting here and there. The latter shatters the coal and causes more debris, at the same time involving liability of accident, to say nothing of the disadvantage of hand picking with picks, etc.

The electric locomotive that hauls the coal from the mine

The Car of All Work

By C. L. Edholm

FARM labor is a term that includes a wide variety of tasks and as the hired man must be a man of all work, so the farmer's automobile, if it is to serve him most effectively must be a car of all work. Many attempts have been made to put into harness the pleasure car which the prosperous farmer of today owns or hopes to own, and the most successful of these is a device which converts the run-about into a tractor in twenty minutes, ready for such heavy labor as plowing; disking, hauling heavy trailers or even pulling stumps. At the close of a day's work, the machine can be changed into a pleasure vehicle in twenty minutes, ready for a spin to town or a visit to a distant neighbor.

The tractor attachment consists of two cast metal wheels on a heavy axle and a channel iron frame. This can be bolted to the car with only four bolts, after removing the rear fenders and wheels. Roller pinions, integral with the brake drum, replace the rear wheels of the car and these mesh into the semi-steel gears on the inner rims of the tractor wheels. The power is applied scientifically, the driving pinions pushing down on the tractor wheels, and as they bear on the rim of the wheels there is no torsional strain on hubs or spokes. The engine not only runs on high gear but starts on high.

Besides these parts, an extra large radiator is furnished, one of the cellular type, six times as efficient as the standard type radiator. This is a necessity in order to prevent the engine overheating under the additional load. A force feed lubricating system to the motor bearings is added as well, which prevents burned out bearings, scored pistons and other difficulties that might result from the ordinary oiling system.

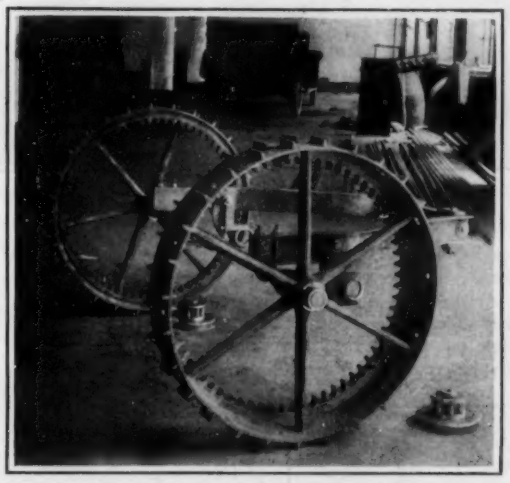
The increase of power is secured at the expense of speed. That is, the engine makes its 1,000 revolutions per minute, just as when the car is going at a speed of 20 miles an hour, but with the tractor attachment, the forward progress is 2½ miles an hour for plowing. By using a different size roller pinion a speed of 5 miles an hour for hauling heavy loads is obtained. Thus the motor is doing its normal work, just as if the car were making its 20-mile speed on an ordinary road.

The tractor wheels have a diameter of 38 inches with an 8½-inch face and are cast of one piece of semi-steel. The gear that meshes with the pinions is bolted to the inner rim. The axle that supports these heavy wheels is of 2-inch, cold rolled steel and no additional strain is put upon the car's axle or chassis.

Concave creepers are supplied which may be bolted to the tractor wheels and as they dig into the soft soil or sand, give the maximum pulling power for plowing and hauling over fields.

A fifth-wheel attachment is supplied which makes it possible to use a small runabout in connection with a semi-trailer, forming a six-wheel tractor-and-trailer. This does the work of a four-horse team for hauling heavy loads such as manure, grain, lumber, etc.

This ingenious means for multiplying the value of the pleasure car has been successfully used by farmers and haulers long enough to demonstrate that it is practical, and it will more than double the value of a motor car to the farmer who owns an automobile.



The tractor attachment that converts a pleasure car into a "car of all work"

High Tension Submarine Cable Between Denmark and Sweden

THE cable which has been laid for the purpose of transmitting power from Sweden to Denmark is remarkable, inasmuch as it is the longest submarine cable of its kind, having regard to the pressure at which the transmission takes place. The power is received by the electricity and tramway company at Hellerup, near Copenhagen, and is transmitted by the South Sweden Power Company, at Malmö; the generating power station is on the Lagan River, about fifty miles northeast of Helsingborg. The original proposal to take power in this form from Sweden met with opposition from the Danish military authorities, as difficulties might possibly arise in time of war, but eventually it was considered that the advantages outweighed the disadvantages. A contract was, therefore, made early in 1914 for laying the necessary cable, and the work was completed before the end of 1915.

The submarine cable is about 5.4 km. (3.35 miles) long, and consists of nine factory lengths, each measuring 600 meters (1,968 feet). The cable is of the three-conductor type, insulated with impregnated paper. It was tested at the works at 87,500 volts, and carries current at 35,000 volts. A great amount of experience has been had with regard to gutta-percha cables for submarine work, but things are very different with high-pressure cables.

The jointing of lead-covered paper-insulated cables at sea is not at all a simple matter, continues *The Electrician*, and all sorts of precautions have to be taken both with regard to regulating the movements of the ship and its laying machinery, and also with regard to the exclusion of moisture from the joints. The greatest depth at which a joint is laid is 38 meters (120 feet).

After the cable had been laid it was tested for half an hour at a pressure exceeding the working pressure by 50 per cent. The whole transmission line is made up as follows: The first portion from the Lagan River is overhead, and carries a pressure of 50,000 volts. There is a transformer station at Helsingborg, where a conversion to 25,000 volts takes place. From this point there is an underground cable, about 4.8 km. long (2.97 miles), to a switch house, situated near Palsjö, nearly north of Helsingborg. At this point the submarine length begins; it reaches land in Denmark at Marienlyst, whence an underground cable 1.5 km. (0.93 miles) long, conveys the power to a sub-station at Elsinore. About 200 meters (650 feet) to the north of the submarine high-tension cable there is is laid a four-cored heavily-armored gutta-percha cable, which is used for telephone purposes; it also serves to protect the high-tension cable from the anchors of ships that may be driven out of their course by stress of weather. On the south side of the high-tension cable there are three telegraph cables. At the present moment only 370 kw. are being transmitted to Denmark, but this is likely to be much increased in the future. Taking into account the present high price of coal, the contract ought to be very useful to the Danish tramway authorities.

Are Wooden Shoes Coming into Vogue Again?

IN view of the abnormal condition of the leather market not only in our own country but in every country of the world, it is with much interest that we receive the suggestion which has been made in London for solving the boot-supply problem. A noted clog maker doing a big business has recently told a representative of the *London Evening News* how clogs are coming more and more into vogue.

Hundreds of London school children are now wearing clogs, which cost about three shillings a pair (about 73 cents) and London County Council school teachers have been providing clogs for ill-shod pupils, who have been paying for them by weekly installments of 3 pence.

The price of leather, states a writer in the paper mentioned, suggests that the city man of the future will clatter to business in his clogs. "For country wear one can buy an elegant pair of lace-up clogs at a quarter of the price of equally efficient boots." Apart from the attention that they would attract, there is no reason why these should not be worn in "town." There is nothing undignified in the clog worn by the Lancashire or Yorkshire textile worker, it is pointed out, and not a few of the captains of the British textile industry have themselves worn clogs, and some at least would not be ashamed to wear them again.

The present home demand in Great Britain is so great that an order for 100,000 pairs of sabots for the Belgian Government has just had to be declined by a British clog-making firm, which received an award for its clog show at a London Exhibition.

Plowing with an ordinary runabout equipped with the tractor truck

Running a reaper with pleasure car and tractor attachment

Shell hole shot in the ship's bottom by the Germans

The plug with which the big hole was closed

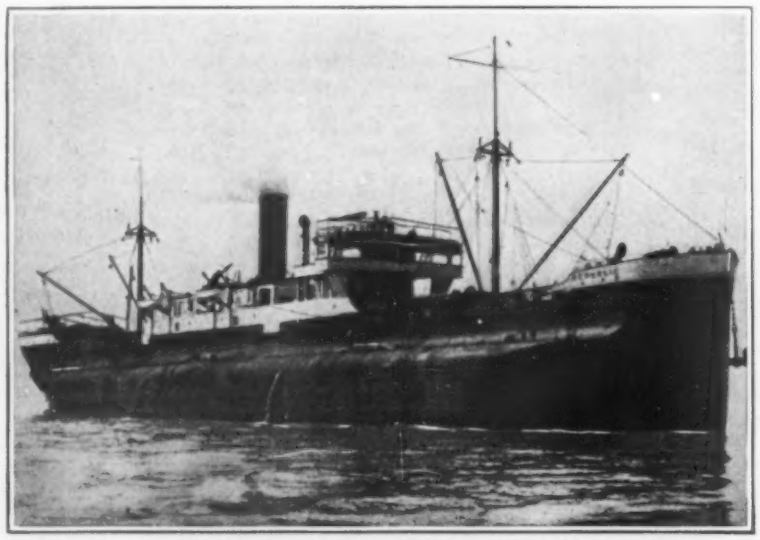
Salving a Big Ship

How the "Republic" was Floated by Building Up Her Sides

IT is a far cry from these modern times of steel liners and submarines back to the days of Archimedes, who found out why a boat will float. Nevertheless, the principle whose discovery sent the Greek philosopher flying down the street with wild shouts of "Eureka! Eureka!" is today employed in the raising of wrecked ships, and has just now had an unusually striking demonstration in the harbor of Papeéte, Tahiti.

The German steamer "Walkure" was taken by the French shortly after the outbreak of war, and brought into Papeéte. Then the German raiders, the "Gneisenau" and "Scharnhorst," happened along and bombarded the port. The "Walkure" was hit but not seriously damaged; but the French feared that a return of the enemy might result in total ruin of this fine ship, so they opened her sea cocks and sunk her in 54 feet of water, where she surely would be safe. Eventually the South Seas were cleared of German warships, and salving of the "Walkure" became in order. So on September 1st, 1915, she was sold at public auction to a San Francisco capitalist for some thirty thousand dollars—less than thirty per cent of her original cost. And then the discovery of Archimedes that an object floats only by displacing its weight of water was brought into play.

The "Walkure" was 350 feet over all, 49 feet beam, and 24 feet in depth, of a peculiar construction known as "semi-whaleback," which is amply described by the name and the picture shown herewith. The whaleback shoulder is called the harbor deck, and it was this feature that suggested the manner of salving employed. In brief, this consisted in building up, from the harbor deck to the water's surface, a false hull or cofferdam, and in pumping out the interior of the taller sided boat thus constructed until it would begin to raise itself. As remarked above, the method is not new, but is seldom applied upon any such scale as was here necessary. The engineer in charge was encouraged to try it by a survey of tide and weather conditions in Papeéte harbor, which made it clear that these would favor the scheme.



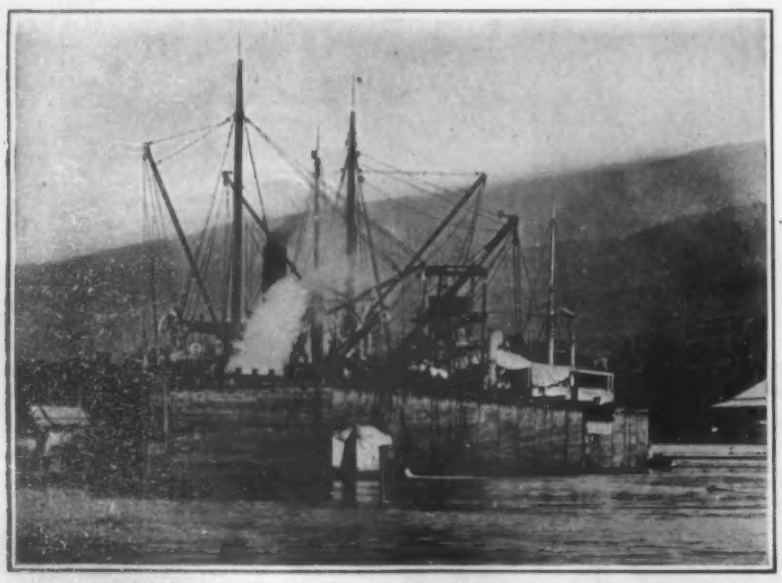
General view of the "Republic," née "Walkure," showing the peculiar semi-whaleback sides

Accordingly an immense cofferdam to extend for 307 feet along the harbor deck was planned. It was 14 feet high forward and 32 feet aft, with an additional V-shaped section built on the rear to encompass the stern. This assured a displacement of about 6,700 tons, more than enough to raise ship and dam combined. The greater height of the dam aft of course, was necessitated by the fact that the vessel lay on a sloping bottom.

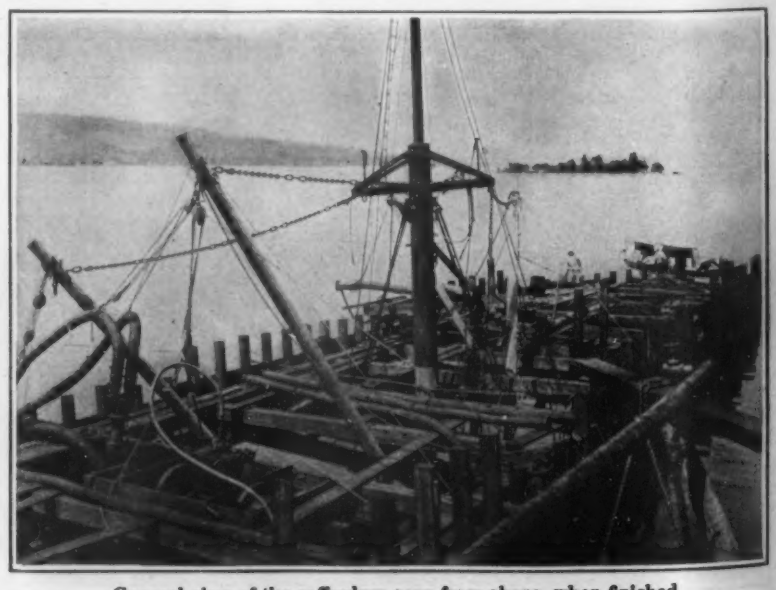
Work of salving began on November 8th, more than a year after the ship's submergence. Some 600 tons of lumber were used in the cofferdam, which was built on shore in 18-foot sections. It was constructed of 2-, 3- and 4-inch planks, the thickness increasing with depth of immersion; these were bolted and nailed to the joists, which in turn were bound with cable. To prevent spreading of the opposite sections under the weight of water and to hold them solidly to their base on the hull they were bound together by a series of articulated tie-beams of round iron 1¼ inches in diameter. Resistance to the crushing force of the exterior water during the pumping out was obtained by transverse beams 12x14 and 14x14 inches, reinforced by longitudinal supports 6x8 and 8x8. Finally, any tendency to buckle was overcome by heavy chains, stretched diagonally.

Watertightness between adjoining sections was assured by nailing bands of sailcloth over the joints. In the corners tight seams were secured by rubber strips wedged into and tightly packed between the sections. The same process was employed to waterproof the seams between hull and dam. Any other places in which leaks might be looked for were blocked with cement.

In addition to the cofferdam it was necessary to patch up the shot holes which the Germans had made in the hull, and likewise the ports which fell outside the limits of the cofferdam. This as well as the placing of the completed dam sections called for the services of



Stern view of the partially raised wreck, showing the V-shaped section of the coffee dam and the separate panels



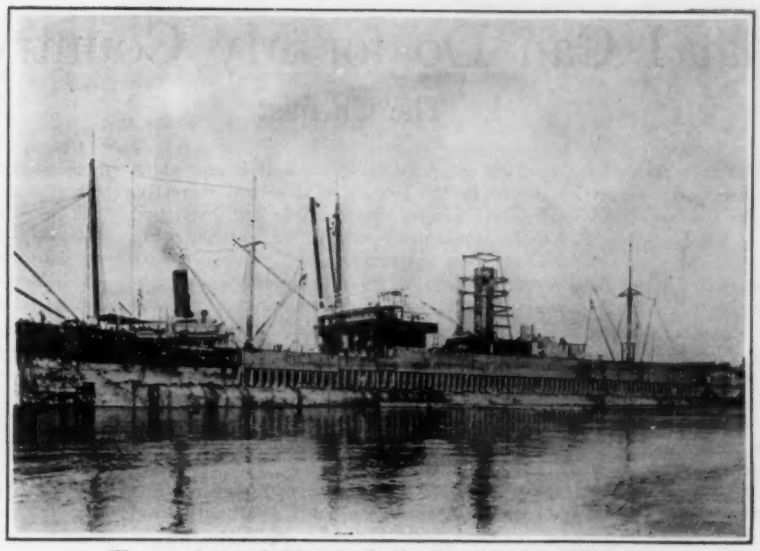
General view of the cofferdam seen from above, when finished and ready for the pumping to begin

divers. Nevertheless, on the 11th of December, after twenty-nine days of work, the thirty-seventh and last section was made fast. Ten days later the four centrifugal pumps had been installed, each in a watertight caisson, and in such fashion as to follow the change of water level inside the dam and thus keep up steady pumping. From this date to January 3d the pumps were kept going steadily, and the ship rose gradually in the water. As fast as she came clear of the bottom she was towed inshore to guard against loss by accident of all ground gained. On the date last mentioned it was possible to pivot the ship about to a position parallel to the shore, and it then became necessary to hold up the pumping for a few days while the ship was lightened by dismantling or trimming of several of the dam sections. After pumping was resumed the vessel floated rapidly, and on the 11th her decks appeared above water.

The native labor employed, although lazy, was surprisingly efficient, and the ability of the Tahitians at naked diving was most valuable in saving the equipped divers for the long jobs. As evidence of this ability, when a cannon-ball was discovered on the floor of the bay in 40 feet of water, a native dived for it and, unable to swim with it, he deliberately walked ashore along the bottom with his load.

A survey of the "Walkure" as soon as she was afloat revealed that she was well preserved. Some four weeks were spent in cleaning her up, after which she was put under American registry, renamed "Republic," and started for San Francisco under her own power, using the German coal in her bunkers and discharging her cargo of German phosphate, partly at Honolulu and partly at San Francisco. Here, of course, she was thoroughly overhauled and put in first-class shape.

To show the profit in this undertaking, we may remark that after paying $30,000 for the hull, the new owner laid out $255,000 on salvage and refitting. He then sent his new ship on one voyage which netted him $360,000, after which he sold her for $825,000. It appears that he got out without serious loss.



The wreck completely raised, showing how the cofferdam was constructed on the harbor deck

Internationalizing the Armored Land-Ship or "Tank"

WHEN the British army first brought into action the heavily armored trucks or "tanks" on the Somme battlefield during the second half of last year, it was said by many that these mobile land forts were only a novelty and that they would be of little use against positions protected by even the slightest field artillery. It was pointed out that the initial success scored by the first tanks was due to the element of surprise, and that in the future the tanks would be of little if any value to their users. Particularly the Germans ridiculed the British tanks, although rumor had it at the time of the Roumanian campaign that the armies of von Mackensen and von Falkenhayn were making good use of the new Teuton tanks in routing the shattered Roumanians.

Whatever may have been the opinions of different military experts with regard to the British tanks, the fact stands that several nations are today busily engaged in developing and constructing these mobile land forts for the use of their armies. Several weeks ago an American-made tank was tested before the United States Army officers at Los Angeles, and a general idea of this machine may be obtained from the accompanying illustration. In principle the American tank is similar to the early British tanks, and like them makes use of a caterpillar-tread propulsion. The armored body is fitted with a number of loop-holes, several of which are provided with hinged doors. A knife-like prow would indicate that the tank should have no difficulty in cutting its way through the stoutest barbed-wire entanglements.

At predetermined and charted points the mines of this mine-layer are dropped overboard

The French allies of the British have not been slow to adopt the tank idea, and in the second illustration appears one of the latest French tanks. This machine, too, makes use of the caterpillar-tread propulsion. It appears to be armed with quick-firing cannon of at least 3-inch caliber, and with a number of machine guns. A novel feature of the latest French tank is the prow-like rail member in front, which serves to crush down or cut barbed-wire entanglements.

An Italian Mine Layer in Action

MINES have played an important part in the naval activities of the present European war, and it is safe to say that in no previous war have mine fields been laid which approached the magnitude of those laid by Britain and Germany in the North Sea.

In the Mediterranean, too, mine fields have been laid by the belligerent nations; and the accompanying illustration is of interest because it depicts an Italian mine-layer at work. It will be noted that the mines are arranged in two rows on the deck of the vessel, and are dropped overboard by the crew at carefully charted points along the vessel's course. Each mine is arranged to sink to a pre-determined depth, where it remains in position. The unsuspecting vessel which comes in contact with the hidden mine, operates a detonator in the head of the mine, which in turn explodes the charge of high explosive. The mine fields of today extend, in some instances, for hundreds of miles, and form an effective barricade against the aggressions of hostile ships.

Potash as a By-Product in Cement Making

A TORONTO newspaper states that a company making Portland cement at Durham, Ontario, is now turning out as a by-product from the feldspar twelve to sixteen tons of potash daily. Feldspar rock is added to the limestone as a raw material for cement, and a process has been evolved for collecting the liberal potash. Both muriates and caustic products are produced, and while the market standard of the former is fixed at 80 per cent to the trade, the company claims that it is possible to produce an article which is almost pure.

This company has eight kilns. The output of potash as a by-product amounts to 15 tons a day. In addition to this, by trapping dust and gases in which there is 5 per cent of potash, valuable fertilizer is produced. The chemist makes the following statement:

Within five years every cement plant in Canada could be producing potash as a by-product. In the feldspar deposits, which extend widely through the northern parts of the Ontario Province, Canada has a natural resource of immense value. There is more feldspar in one county of Ontario than in the whole of the United States. It contains at least ten per cent of potash, and through the process employed at Durham more than eighty-six per cent of the pure article is collected.

The cost of manufacturing potash in Canada is so low even now that it is less than the freight charge paid on a ton of the imported German product before the war. The result of this discovery will be the complete breaking of the German monopoly. In addition to guaranteeing a much-needed supply of potash for the present urgent demands, it will result in meeting the needs of the American continent for fertilizers.

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Army officers at Los Angeles witnessing the tests of an American-made "tank" going through the various military maneuvers

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One of the latest "tanks" or mobile land forts employed by the French army Note the prow-like cutter for barbed-wire entanglements

What I Can Do for My Country

I. The Chemist

UPON the chemist perhaps more than upon any other trained worker, the war will make special demands; certainly to no other will it offer wider scope for action. There will be few new problems for him to attack, little for him to do which he has not already learned by actual experience how to do; but his work will be presented to him upon a scale heretofore undreamed of. It will be necessary in chemistry more than in any other field for every unit of man-power—and this of course includes woman-power—to be placed in precisely the groove where training and inclination make it fit best.

To a certain type of lay mind mention of war chemistry will call up a vision of a bewhiskered and bespectacled person, manipulating the mysterious contents of equally mysterious tubes, in an effort to concoct the super-explosive—and, likely as not, blowing himself and his laboratory into the next county with an unexpected success. The true picture, however, is nothing like this. Experiments are for times of peace. When we are at war, we must be content to produce as much as we can, by the best methods we know; and this applies not alone to the actual ingredients of destruction, but to all things. The interruption in production which would result from a change in technique, with the consequent change in equipment, is not to be thought of. We cannot swap horses while crossing the stream. What we have not invented before the war must in almost every case, wait till after the war; so that for actual chemical research work we shall have little place during the impending conflict.

All of this is more or less familiar to the chemist; in any event, it will come as far less of a revelation to him than to the layman. For the chemist realizes, as the layman never can, the tremendous demand made upon chemical knowledge and technique by the mere operation of known processes. When chemistry works out a procedure for, say, the treatment of armor-steel by means of complicated heating and reheating, alloying and realloying, it does not throw the work of maintaining this procedure into the charge of a few skilled factory hands, and turn itself loose upon a new problem. It has to stay right on the steel job, testing each alloying compound before it goes into the mass, supervising all the little details of the operation for which it alone knows the reasons—testing, testing, testing, bossing, bossing, bossing, eternally and always.

Every high school student knows by his own experience or that of others that one does not pour water into acid, but rather achieves this mixture by pouring the acid into the water. There are hundreds of little details more or less analogous with this in the complicated processes of steel making and tempering, and alloying; details which only the chemist is competent to prescribe the right way of doing, of which only the chemist is competent to supervise the doing. And so it is in every other line of industry where chemistry enters at all. For every purely research worker, whose interest in a given technique is temporary, lasting only until the problem has been solved and replaced in his mind by another, we will find a score or a hundred of these factory chemists who must stay with that technique indefinitely, checking up and controlling all materials and all operations. And it is here that we must look for the excessive demands of war upon our supply of chemists.

First place in any catalog of specific industries which will have to issue an emergency call for chemical workers goes, of course, to the manufacture of explosives. Few indeed are the substances whose assembling, at every stage from raw materials to finished product, calls for such careful attention to every detail. The nitrate bases must be absolutely correct, highly pure; the same remark applies to the stabilizing elements; proportions must be verified and verified and verified again; the utmost care must be taken at every step to insure against accidental explosion, and to exclude all possibility of subsequent deterioration. The latter aim alone is one calling for the nicest chemical knowledge. Who but an experienced nitrate chemist can say, for instance, just what proportion of extraneous material of a given nature may enter a tube of nitro-glycerine without causing deleterious reaction? Who else can prescribe means to limit such content to the safe maximum? Who else can state whether a certain factory accident has caused this limit to be exceeded?

Not only is the technical problem of explosives a very delicate one, but on practical grounds it is one which must be settled in the factory, and settled correctly. Most items can be tested after completion; by actual test it can be determined whether or not they will function. But when the function of a substance is to explode with sufficient violence to spread destruction over a wide area, it is quite clear that the extent to which it can be tested by trial is limited. More than any other manufactured substance, an explosive must be tested by actual use; and with the proof of the pudding so largely confined to the eating, a very great responsibility rests upon the factory chemist.

We are not, of course, so badly off for competent chemists in this field as we should have been three years ago. Our export of explosives has leaped from $6,000,000 in 1914 to $467,000,000 in 1916; and this vast output has had to be produced under the same conditions of rigid chemical control as though intended for our own consumption. But it is quite clear that even this large production must be materially increased if we are to enter the war, either as an active belligerent or as an officially recognized and permanent source of supplies for the present belligerents. Hence the demand for chemists competent to handle the manufacture of explosives will be greatly increased. This demand can only be met if every one of us who is a chemist or an ex-chemist or a near-chemist by vocation or by avocation, and whose ability or inclination lies in this direction, makes his services available. Nor is it merely a matter of putting together the standard high explosives. Stabilizers, detonators and fuses also enter; time fuses present a most interesting field; and the inflammable liquids, the incendiary bombs, the lighting bombs and trailers, are all important side-lines under the general caption of explosives, each of which makes its own peculiar demands upon the chemist.

Of importance almost, if not quite, equal is the rôle of the chemist in the steel industry. It may be true that "pigs is pigs," but certainly, until its intended use is known, no man can say that steel is steel. Between the steels used for armor-plate, for armor-piercing shells, for the ordinary projectiles used by the various types of rapid-fire guns, howitzers, mortars, field-guns and siege-guns, for these weapons themselves, for rifle barrels, for structural work, for permanent or temporary rails, for wheels and axles, for helmets, for automobile and aeroplane and engine parts, there is sometimes almost as much difference as between steel and bronze and copper, and tin and iron and zinc. Accordingly, for the metallurgist—who is really only one special kind of a chemist, and who therefore falls properly within the scope of this article—for the metallurgist who has had the slightest degree of experience in the technical processes of making steel for any of these or the many other purposes which count in time of war, there can be no question as to the channel through which his services will be of most value. The slightest degree of special knowledge of the chemistry of steel and the alloy metals employed to modify its physical properties, the slightest natural aptitude in this direction, can be made available in connection with the chemical control of steel production.

While steel presents the greatest scope to the metallurgist bent on serving his country in time of war, the man whose knowledge or inclination looks toward other branches need not despair of being of value. The bronze employed in the making of shrapnel bombs, in the metal parts of naval and military uniforms, and in small hardware generally presents work for the chemist of much the same nature as that which he can do in the steel mill. Of even more consequence is the contribution of chemistry to the extraction of all metals from the ores—the iron for making steel, the copper for projectiles and electrical uses, the zinc and tin, and rarer metals for alloying and for many other special applications. Smelting and refining has been reduced to an exact science in much greater degree than have most technical processes; but even so, it cannot begin to divorce itself from chemical support and supervision.

The chemistry of oils and mineral miscellanies also has its place in the technology of war time. The rôle of petroleum in automobile and aviation work is obvious enough; perhaps not so obvious is the fact that reduction of the various crudes is not a process which can be carried on by two-dollar laborers without chemical supervision. And if this is so when the goal is the comparatively simple gasoline, what of the many products of far more complicated nature, all of which fill some niche in the general scheme of war operations? Then, too, the demand for lubricating oils on the part of military and industrial units will be abnormal, and must be met at all costs; but their production involves chemical intelligence of a high order. The commercial chemistry of alcohol is far from simple, yet this substance will be used on a large scale. A great variety of paints will be called for in larger quantities than usual—paints for lending invisibility to man and equipment, paints for security against weather action, chemical change, etc., paints for new factories and storehouses, autos and planes, and railroad equipment; and here again we must have appropriate chemical control of manufacturing processes. Glues and varnishes, gums and resins, greases and fats, must all be turned out in abnormal quantities without delay and without sacrifice of quality. Insulating and protective substances for electric wires, as well as waxes and hard composition materials of various sorts, will be called for in increasing measure as we proceed with actual military operations or take over more and more of the work of supplying the Allied fronts. All in all, we have in the materials enumerated in this paragraph a chemical precinct of extraordinary range.

The rubber and leather chemists might, perhaps, be included above; but they occupy fields so distinct from all others that we prefer to mention them separately. The experience of Germany has brought home with great force the fact that rubber is indispensable to transportation and electricity; and we shall also have wide use for it in the manufacture of waterproof garments. The demand for leather in the making of shoes, belts, masks, gloves, hoods and many other small and large articles of apparel, as well as in the automobile factory and the hospital, will be large. And practically everything of rubber and leather is short-lived. Shoes wear out like magic under active military service; and it is in the very nature of rubber to deteriorate rapidly. So we must produce unprecedented quantities of both these materials. Now it goes without saying that in the absence of competent chemical supervision we cannot have rubber; and the most casual consideration should convince the most hopelessly non-technical mind that the mysterious processes of tanning depend absolutely for their success upon the chemist.

After leather—perhaps even before it—the great bases of all our clothing are wool and cotton. We make tents and a few other things of canvas; we employ hemp and jute in the production of rope. For ordinary purposes,

(Concluded on page 359)

IT is clear that war is no longer a mere question of going out in armed force and shooting at the enemy. There are very many other things which equally must be done. It is vital that all men of conspicuous ability in any of these collateral activities be kept from the firing line.

Under a deliberately organized military system, the outbreak of war places upon the individual no responsibility of decision. He fights or works under orders from above. In the war which is being thrust upon us we have no such organization. In very large measure each citizen must decide for himself in what direction he can best serve his country.

In an effort to place before the citizens of the United States suggestions which will aid them in making this decision intelligently, the SCIENTIFIC AMERICAN has planned a series of articles under the above caption, of which the first is presented herewith. While plans for the series are not complete, and are necessarily elastic, it is intended to follow the present article with others addressed to the civil engineer, the mechanical engineer and the machinist in general, the electrical engineer and the electrician, and various others. It is, of course, not hoped to tell these men anything which they do not know about their work, but merely to point out to them the particular fields in which their special knowledge can make their services of most value.

For the idea which stands behind this series, and for the concrete suggestion of the title, the SCIENTIFIC AMERICAN takes pleasure in acknowledging its indebtedness to George Perrine, late Adjutant Captain of the 71st Infantry, New York.

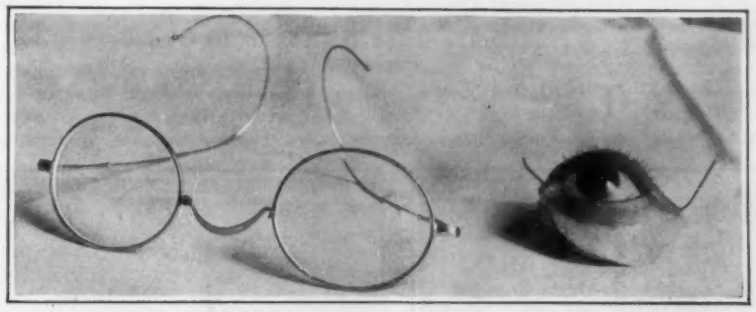
—THE EDITOR.

A New French Artificial Eye

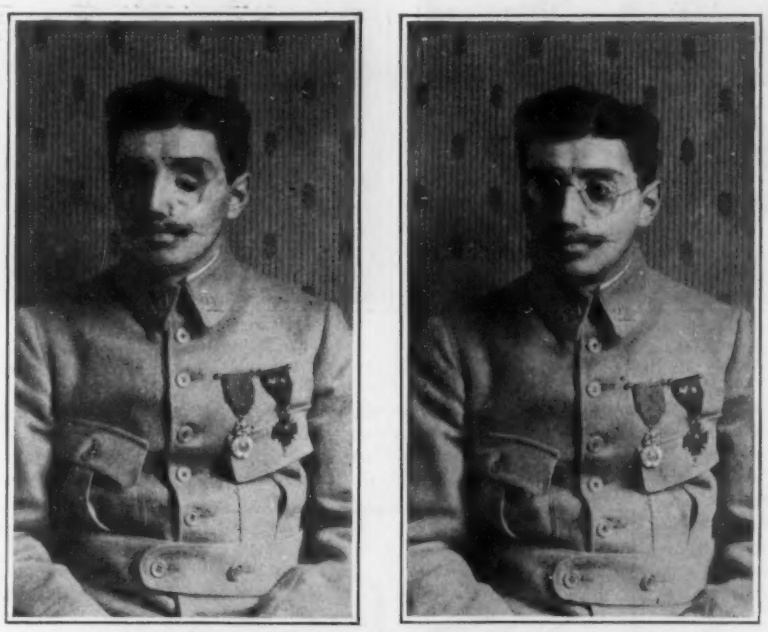
THE high velocities and high explosiveness of the present day projectiles often result in facial wounds of most horrible appearance, in the repair of which the surgeons meet with extreme difficulties. In particular, soldiers return from the line of fire not merely with an eye shot out, but with the entire lid and eye-socket destroyed, and the absence of these foundations has often made the insertion of an artificial eye impossible. Until the present moment there has never existed any means for concealing this disfigurement and restoring to the unfortunate victim the appearance of a normal man possessing two eyes. But quite recently a French oculist, Henri Einius, has made it possible to do this even when the eyelid is entirely missing. The success of his method is abundantly testified to by the pictures which we show of a French sergeant with and without his new artificial eye.

In its essential features the apparatus consists of an artificial eye, equipped with a lid of any convenient plastic material—paraffin or molding paste, colored to match the subject's complexion. This eye is furnished also with lashes, to give to it the fullest possible extent the appearance of a natural eye. It derives its support from fine metal wires attached to eyeglass or spectacles, so adjusted that when the latter is placed upon the nose, the artificial eye falls accurately into its cavity. The eye may easily be separated from these attachments for cleaning.

In case it is desired to have a somewhat stronger pressure upon the ocular cavity, the supporting wires may be replaced by light springs of toric or other shape; and in pursuit of a similar goal there may be inserted, behind the artificial lids, a washer of elastic gum to prevent the entrance of dust.



The artificial eye recently devised in France

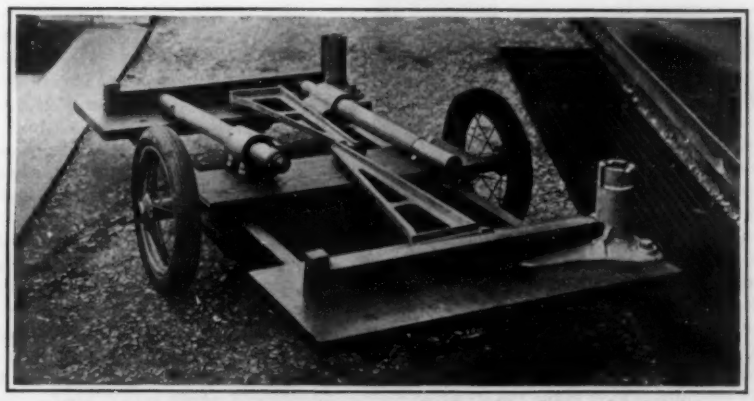


French soldier with mutilated eye, before and after being fitted with the new artificial member

A Double-Deck Stretcher which Travels on Wheels

TO facilitate the transportation of hospital patients there has recently been invented by Thomas Crawford of Bristol, England, a double-deck stretcher mounted on a pair of wheels. Under the old methods it required two men to carry a stretcher with its human load, but the present appliance makes it possible for a nurse to wheel not only one but two patients from place to place.

The stretcher-transporter, as the new device is named, is of sturdy construction. It is equipped with pneumatic-tired wheels so that the patients may not be subjected to jolts. A pair of standards carrying horizontal arms can be inserted in sockets when necessary, providing support for the upper stretcher as shown in one of the illustrations. On the other hand, when the stretcher-transporter is not in use the standards are taken down and the device is then ready to be stored in a small space.



The stretcher-transporter with the standards taken down, showing its compactness when not in use

Sponges from the Rubber Tree

A NEW method of preparing rubber sponge direct from the latex or sap of the rubber tree has been patented, and it bids fair to make the product much cheaper.

Rubber sponge has several peculiar properties. For instance, it is exceedingly light, its specific gravity compared with water being 0.05, which makes it about the lightest solid body known. Although it is full of holes, the holes are independent, they are not connected with one another, so that it is watertight and very nearly gastight. It is ideal for life-preservers because it will not waterlog; it is light, conforms easily to the body and it will not collapse. A life-raft made of rubber sponge is as nearly fool-proof as it can be.

Most automobile tire fillers have gone into the discard because they do not respond or because they heat up or decompose; but rubber sponge is promising. It is to be molded to fit the inside of the tire casing.

Rubber sponge is also useful in making soundproof rooms and for placing under light vibrating and hammering machines. It is further proposed for clothing for aeronauts and for Arctic work.

Hard rubber sponge is the well-known hard rubber, but in a spongy state. It weighs a quarter as much as cork and one-tenth as much as light wood. It is suggested for battery jars, and for many kinds of insulation. It may be worked in any way customary with hard rubbber.

Will Your Next Suit be Made from Peat Fiber?

A PROCESS is stated to have been perfected in Sweden for the manufacture of a strong textile material from peat fiber. The inventor, an engineer named Jegeaus, began to study this process 20 years ago, but was hampered by the fact that the manufacture was much too costly, so that he was unable to turn his ideas to any practical use. Induced by war conditions, however, he resumed his experiments, and has now succeeded in making dress materials from peat on a large scale.

The prices of these fabrics are said to be somewhat lower than those for artificial wool, and the durability great. The inventor himself and several other persons are already wearing "peat" clothing, and a factory for the working of the process is about to be erected.

A New Waterproof Cloth

A NEW waterproof fabric has been introduced in France and is proving very satisfactory for hospital sheetings, etc., as well as for waterproof garments. Very thin slices of cork are cut from the block by special machinery, according to the *Journal of Industrial and Engineering Chemistry* which describes the special process. These slices are placed in chemical baths to remove the resinous parts which make the cork more or less brittle. After this treatment the cork sheets may be folded or bent without breaking. They are then attached on both sides to layers of cloth, and the resultant material is not only very light but porous, thus providing for ventilation. It is said to be desirable in every way as waterproof fabric.

Internal Heat of Planets

THE late Prof. Lowell's discovery that Saturn does not rotate as one piece, but has "confocal layers, rotating faster within," suggests that some of the other large planets may have the same structure. As pointed out by Prof. Very, the friction of layers of different velocities would generate heat, and thus retard the cooling down of these planets.

The new British stretcher-transporter arranged to carry two patients

The stretcher-transporter arranged to carry one patient by turning the horizontal arms out of the way

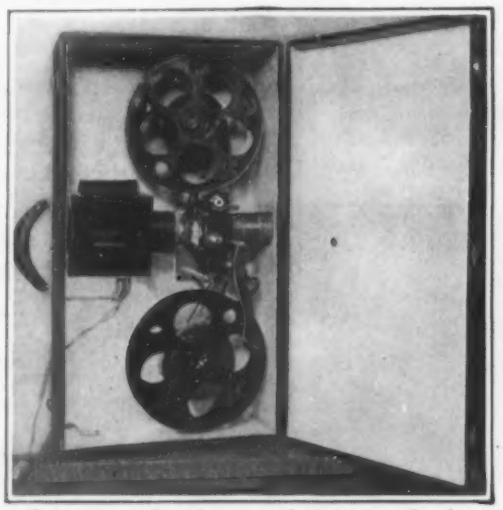
Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

A Motion-Picture Show in a Suit Case

THE constantly increasing use of motion pictures in salesmanship and by important commercial and industrial organizations has brought forth a wide variety of portable projectors of exceedingly light weight and of compact design. And while many of these machines have met with considerable success, for the most part they have not quite filled the requirements of their users. In the first place, they have not been provided with film magazines or retorts to prevent film fires, and thus their use has been largely limited to non-inflammable film. Secondly, they are carried about in a more or less dismantled form, so that a considerable amount of time is necessary to set them up. This last point is an important one in the instance of the salesman who must not take up more of his prospective customers' time that is absolutely essential.

A solution of the portable motion-picture projector appears to have been solved in the suit-case projector, which is veritably a complete motion-picture show. As will be noted in the accompanying illustration, the new projector is designed along conventional lines and mounted in an asbestos-lined suit case. The lens barrel passes through a hole in the suit case, and the same is true of the crankshaft. While it is a fact that the film reels are not encased in retorts or magazines, the machine is nevertheless fireproof because of the asbestos lining, which virtually corresponds to the asbestos booth in a theater. The suit case is closed when the film is being projected. Included with the suit-case projector is a daylight screen which is carried inside the case. The projector and screen can be instantly set up and the picture shown in any office, day or night. A 250-watt incandescent lamp used in the lamp house of the machine is sufficient to project films up to 40 feet with satisfactory results. The suit-case projector, complete, weighs only 23 pounds.

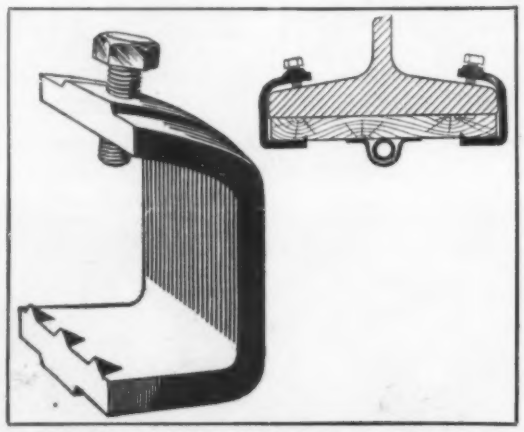


Suit-case motion-picture projector open, showing the mechanism. Note the asbestos lining

How the suit-case projector is employed by salesmen in bringing motion-picture demonstrations to a prospective customer's desk

A Universal Girder Clip

THE general use of steel-girder construction has made a well-designed universal girder clip an important accessory in wire installations. The wide variety of sections met renders it most troublesome to clamp conduits and other fixtures to the underside of girders. The clip which meets these conditions is shown in the illustration and consists of a pair of clamps which fasten on to the edges of the girder and hold a wooden spline. Saddles for the conduit, junction boxes and other accessories can be fixed to this by an ordinary wood screw. The clamps are made of tough malleable iron and are provided with a set-screw for drawing the wood tight up to the underside of the girder, two or three sharp points being arranged to secure the wood, which really provides the packing for the clamp. For angles or odd sections a batten can be spaced along the free edges.



With this clip lighting fixtures, etc., can be firmly attached to any girder

A Rifle That is Aimed by Means of Its Own Periscope

THERE has been no end to the application of the periscope to rifle sighting in the present trench warfare in Europe, but so far as is known there has been no attempt to develop a gun in which the periscope is an integral feature. For this reason the appearance of a periscope-sight rifle in this country is of considerable general interest. S. A. Guiberson, Jr., and L. L. Richards, of California, have invented a periscope-sight rifle which makes it possible for the marksman to take careful aim and fire his weapon without exposing himself to enemy fire. As will be noted in the two accompanying illustrations, they have taken the standard Springfield rifle and rebuilt it to serve their purpose. The stock is hinged in the manner shown, so as to bring the butt down to the shoulder of the marksman while maintaining the barrel in a straight line. The periscope member consists of an adjustable mirror supported on a variable support, and a fixed mirror. When desired the new rifle can be closed up and used as a standard Springfield rifle, which is obviously an important advantage.

Important Maya Remains

SOME notable results of Mr. Sylvanus G. Morley's archæological explorations of last year, recently reported, include studies at the ruins of Tuluum, on the east coast of Yucatan, and those of Uaxactun, northern Peten, Guatemala. Tuluum was first described by the American traveler J. L. Stephens, in 1840, but since the War of the Castes, which ravaged Yucatan in 1848, it has been closed to investigation. Maya Indians took refuge in this region after their defeat by the Mexicans, and have kept up a guerilla warfare and remained virtually independent. The site of Tuluum has been visited only twice since Stephens' time viz., in 1911 by an expedition from Harvard University, and in 1913 by one from the school of American Archæology. Both visits were merely brief reconnaissances. Mr. Morley's party learned that friendly relations between the Mayas and the Mexican authorities had been established for the first time in many years, and they accordingly hired a small steamboat at Belize and proceeded to Tuluum. A hieroglyphic monument having a Maya date corresponding to about 290 A. D. was drawn and photographed, though most of the remains at this place appear to belong to a period later than 1200 A. D. Various maps, building-plans, tracings and photographs were made. The expedition to the site to which the name Uaxactun was given resulted in finding the remains of a large city and the oldest monument yet reported from the Maya field. This monument, described as Stela 9, belongs to Cycle 8 of Maya chrononology, its date corresponding approximately to 50 A. D. The region in question is new to archæologists, having been penetrated for the first time by chicle-gatherers about three years ago. Other important sites are known to exist beyond Uaxactun.

Mr. William L. Symons, for some time Assistant Examiner in the United States Patent Office, particularly in connection with Trade-marks and Designs, has recently resigned his position. Mr. Symons is possibly known better as "Author of Law of Patents or Designs, Copyright, Prints and Some Labels," and also in connection with his articles on Copyrights and Trade-marks in Modern American Law.

Copyrighted, International Film Service

The new periscope-sight army rifle designed by two California inventors, opened up for trench work and closed up for regular use

Copyrighted, International Film Service

The marksman, using the newly-invented periscope-sight rifle, can take careful aim at the enemy without exposing himself to return fire

The Heavens in April, 1917

(Concluded from page 347)

the meridian, and on the right a small but conspicuous quadrilateral, whose upper edge points toward the bright star first mentioned. The small group is Corvus, the Raven, while the bright star, Spica, is the principal luminary of Virgo. High up in the southeast is Leo, marked by the familiar sickle, and the second magnitude star Denebola in the hindquarters. Arcturus, the brightest star in sight, forms a fine large triangle with Denebola and Spica. Below Arcturus in the southeast are Ophiuchus and Serpens, and the head of Scorpio is rising. The bright star low in the northeast is Vega, and Hercules and Corona may be found on the line joining this to Arcturus. In the north we find Cassiopeia and Cepheus below the pole. Ursa Minor and Draco, higher up in the north-northwest and the Great Bear almost overhead. Auriga and Gemini are the most conspicuous constellations in the northwest and west, and Canis Minor is to the left of the latter. The ungainly length of Hydra, extending from near Procyon to a point below Spica, brings us back to our starting point.

The Planets

Mercury is an evening star this month, and is best visible towards its close, being at greatest elongation, 20° east of the Sun, on the 24th. At this time he is on the borders of Aries and Taurus, and 21° north of the equator, so that he remains in sight until 8:30 P. M. At the end of the month he is very near the Pleiades, and is still easily visible just after dark. He is as bright as Procyon, or brighter, and exceeds any star within a long distance. This is an unusually good chance to see him, and one which the amateur should not miss.

Venus is in superior conjunction behind the Sun, on the 26th, and is invisible this month.

Mars is a morning star, but so near the Sun as to be practically invisible. Jupiter is an evening star, setting at 8:30 P. M. on the 1st, but is lost in the twilight before the end of the month. On the 16th, he is in conjunction with Mercury—the latter being 3° to the northward. The two planets should form a pretty pair in the twilight.

Saturn is in quadrature with the Sun on the 14th, and may be considered an evening star, though he does not set till 1:30 A. M. Uranus is a morning star in Capricornus, rising about 3 A. M. and hard to observe. Neptune is in Cancer, almost stationary in the heavens, remaining all through the month within about 2′ of arc of the position 8h. 17m. 20s. +19° 29′. He is observable on the early evening.

The Moon is full at 10 A. M. on the 7th, in her last quarter at 3 P. M. on the 8th, new at 9 A. M. on the 21st, and in her first quarter at midnight on the 28th. She is nearest the earth on the 18th, and farthest away on the 2d and 30th. During the month she passes near Neptune on the 1st, Uranus on the 16th, Mars on the 20th, Venus on the 21st, Jupiter and Mercury on the 22d, Saturn on the 27th, and Neptune again on the 28th.

Mellish's Comet

A telegram received this morning announces the discovery of a comet by Mellish in right ascension 2h. 7m., declination 14° north. Nothing but this rough position is as yet in hand, and no prediction can therefore be made regarding the future visibility of the comet. The discovery-position is about 3° west and 1° north of Jupiter, which should at present serve as an easy mark for finding it in the western sky.

Princeton University Observatory
March 21st, 1917.

Airmen and the Weather Bureau—Partners

(Concluded from page 342)

expecting the craft to heel at an uncomfortable angle as it was brought around. Nothing of the sort occurred; as Dr. Carpenter remarks, "Theoretically one may be ever so well grounded in physical laws, but it seems to take actual experience to bring their truth home to us. Of course there can be no wind *in* the air; when we entered the air it was moving 30 miles an hour in relation to the earth but as soon as we were free of the earth, the velocity of the wind had no effect on our flight. No matter how strong the gale, so far as it concerns our aeroplane, if the wind be steady, no difficulty is experienced; the aviator is concerned only by wind-shifts." This comment explains the practical value of sending aloft such scientists as deal with aviation matters, as a first hand knowledge of conditions gives weight to their research that no amount of theoretical knowledge can replace.

The plunge through the velo cloud was undertaken next and it was observed to be four or five hundred feet thick, with a ragged edge extending inland, while its seaward edge was clean cut and lay parallel with the coast for ten or fifteen miles. Where the vision was not obscured by the cloud, objects could be seen with remarkable clearness. Automobiles could be discerned easily at a distance of 20 miles, the city and the aviation school were sharply defined in every detail and the bay and ocean were absolutely transparent to the bottom. No submarine could hope to hide from an aerial observer any more than it could if the water were swept from the sea, for objects under the surface were distinctly visible from the aeroplane.

The descent was made in wide spirals, and in connection with the landing, Dr. Carpenter remarks on the little known fact that the *color* of the landing place has its effect upon the machine. Land which is dark from being plowed or burned over will heat the air above it faster than will a field of stubble, the difference being due to the varying absorption and reflection of sunlight. A landing place which has an area of heated air above it is dangerous, as the air disturbance gives insecure support for the planes. One of the aviators told of attempting such a landing and being tossed upward by a warm current when he had almost reached the ground.

The thorough manner in which the school on North Island is attempting to solve the airman's problems is quite in keeping with its past history. It was established in 1911 and has been the scene of several important achievements. Here was flown the first seaplane by Glenn Curtiss; from here various cross-country flights were made, and a recent flight of importance was an altitude record. In February 1916, a California-built tractor seaplane carrying three passengers reached an altitude of 12,362 feet, the best previous record for similar conditions being 9,000 feet. This machine has a 125 horse-power motor and carried besides the three men, 26 gallons of gasoline and four gallons of oil, a total weight of 3,100 pounds.

The location of the school is ideal. North Island is really not an island, but is connected by a narrow sand spit with the Coronado Peninsula. Across the Bay is San Diego to the north, the Pacific Ocean is to the south, and the narrow entrance to the harbor is to the west. There is an area of hundreds of acres, free of wires or other overhead obstructions, so that the novice has here an opportunity for flying over clear land and operating the seaplanes upon rough water and smooth.

The period of probation for officers who volunteer for aerial instruction is less than ninety days. In that time, if his superiors consider that he lacks the temperamental qualities of caution and judgment, he is weeded out. The technical skill may be acquired, but the airman's temperament is born in him. An essential feature of the course is detail in the repair shop, and the gas engine is studied both for motor trucks and aeroplanes. Flying is done in the early morning hours and there are lectures twice a day. The machines are equipped with dual control, so that the instructor can take charge of the aeroplane in an emergency. After each flight with a pupil, the instructor reviews point by point the details of the practical lesson just completed, pouncing on every error and explaining the correct procedure. The course is one of hard work and hard thinking, and only first-class men can complete it.

During 1915 the students made 3,652 flights, with a mileage of 95,000 and a total time aloft of 1,516 hours, work progressing regardless of weather conditions.

$1150 F.o.b. Racine
Mitchell Junior—a 40 h. p. Six
120-inch Wheelbase

$1460 F.o.b. Racine
7-Passenger—48 Horsepower
127-inch Wheelbase

Mitchell SIXES

A 40-Year Car

Several Mitchells, built by Mr. Bate, have run over 200,000 miles. That's about 40 years of ordinary service.

But now Mr. Bate has doubled most of his margins of safety. Every vital part has 100 per cent over-strength. So any Mitchell, with ordinary care, should render lifetime service.

Over 440 parts are built of toughened steel. All safety parts are vastly over-size. Many parts are built of Chrome-Vanadium.

Gears are tested for 50,000 pounds per tooth. Engines must run, under heavy load, for 10,000 miles without wear. In two years not a single rear spring has broken.

No Extra Cost to You

All this added strength means no extra cost to you. All the Mitchell extras are free. Yet they include

31 unique features—
24% added luxury—
100% over-strength.

There are 31 features—like a power tire pump—which nearly all cars omit. There is beauty and luxury such as you see in no other car in this class.

This year we added 24 per cent to the cost of finish, upholstery and trimming. But the savings made in our new body plant pay it all.

The New $1150 Model

This year we build two sizes—Mitchell and Mitchell Junior. Even the smaller Six is roomy and powerful. You never saw such a car at this price.

All these marvelous values are due to John W. Bate, the famous efficiency expert. He built and equipped this mammoth plant to build this one type economically. His methods will save us, on this year's output, at least $4,000,000. That saving pays for all these extras. No other fine car offers anywhere near such value.

Go prove these facts, in justice to yourself. They are bound to win you to this Bate-built car.

TWO SIZES
$1460 For 7-Passenger Six—48h. p. 127-inch Wheelbase.
$1150 For Mitchell Junior—40 h. p. 120-inch Wheelbase Six.
Both Prices f. o. b. Racine

MITCHELL MOTORS COMPANY, Inc.
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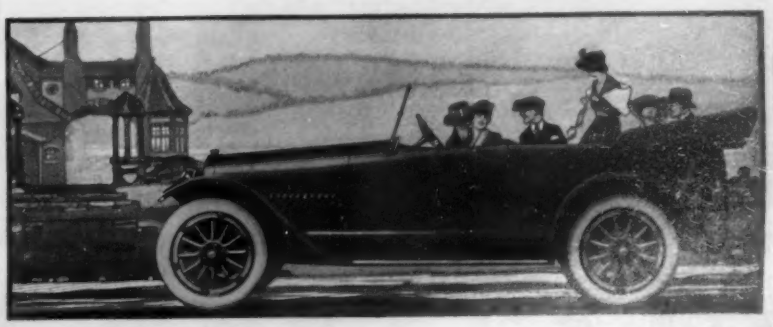

The concrete on the Mason City-Clear Lake Road, Iowa, makes it clean and durable. T. H. McDonald, State Engineer, Ames, Iowa; Slingerl & Munson, Nevada, Iowa, Contractors.

Transportation Goes Back to Public Roads

Railroads built up a great commercial empire in this country and developed a volume of traffic which has outgrown their facilities. Our country requires greater flexibility in its transportation facilities. It cannot be limited to tracks, yards and trains. It must have broader avenues of traffic —country roads strong enough and extensive enough to carry the short distance traffic which is least profitable to the railroads. Already there are three million motor cars in the United States, with a carrying capacity in passenger miles far in excess of the railroads.

The Building of Permanent Roads

in connected systems, is one of the most important undertakings confronting the American people. The nation is awakening to its needs. The good roads movement is growing. The national government has appropriated $75,000,000 for federal aid. States are spending millions to improve highways.

People are realizing the need for immediate action on the building, not only of county roads, but also of state roads which connect important towns by a continuous highway system. A bond issue, preferably a state bond issue, is the adequate and fair method of financing the undertaking.

Concrete Fulfills All Conditions

This is just as true of concrete for roads as it is of the use of concrete in many other forms of engineering construction where strength and durability are necessary. No road surface less durable than concrete will stand the constant pounding, thrusting and shearing of power driven vehicles. It is hard and unyielding; even, but not slippery; rutless, dustless, mudless. Concrete roads have the added advantage of moderate first cost, being within the financial reach of any community. They require very little maintenance; the maintenance is built into the road.

This Association has facts and figures about the construction, service, and financing of concrete roads. Some of them are given in the interesting illustrated booklet, "Concrete Facts About Concrete Roads." A free copy will be mailed to you on request. After you have read it pass it on to your neighbor or road officials, or send us their names and we will take the matter up with them direct. Write today for Bulletin No. 136.

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CONCRETE FOR PERMANENCE

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of SCIENTIFIC AMERICAN.

Pertaining to Apparel

HOSE SUPPORTER.—C. J. HAUBEN, 368 W. 50th St., New York, N. Y. In the present patent the object of the inventor is the provision of a new and improved hose supporter arranged to insure perfect freedom of the wearer's body and limbs and without producing undue strains on the hose and thus preventing tearing the same.

SPRING HEEL.—A. S. GAY, 3428 Lombard Ave., Everett, Wash. This invention relates to spring heels for shoes, and one of the main objects thereof is to provide resilient means for taking the load at the rear of the heel to prevent strain on the spine of the wearer while at the same time affording a firm support when the foot is flat on the ground. Mr. Gay has invented another spring heel for shoes and other footwear wherein the entire heel yields to load when the weight of a wearer is brought thereon.

Of Interest to Farmers

PITCHFORK.—E. L. BELL, Hoxie, Kan. The object of the present invention is the provision of a clamping or retaining device engaging the fork and handle portion thereof for preventing accidental displacement of the parts and also to reinforce the structure at the point of greatest strain.

PLANT PROTECTOR AND IRRIGATOR.—T. J. SHERIDAN, Charleston, S. C. The object here is to provide a series of plant protecting frames including water and snow shedding wings capable of raising and lowering to more or less cover the plants, and having operating devices for the wings of such nature as that the frames may be coupled in a series for simultaneous operation of the wings throughout the series.

Of General Interest

MEMORIAL BURIAL VAULT.—I. S. DAULEY, 43 Broad St., Oneonta, N. Y. This vault construction is adapted to be kept in perfectly air and water tight condition both before and after interment. The invention provides a concrete burial vault having receptacle provisions in its bottom to receive the moisture due to the process of decomposition of the body and to thereby prevent the disintegration of the casket and the destruction of the ornamental lining thereof.

APPARATUS FOR LIQUEFYING AND SEPARATING GASES.—RUDOLF MEWES, Berlin, Germany. This invention relates to an improvement of the process for liquifying air and other gases described and claimed in Mr. Mewes' former patent No. 1,188,191. According to the present invention the raising of the temperature of the gas mixture in the separating chamber is also effected by gas at a higher pressure introduced in a coil and then expanded into the chamber and thus producing a very low temperature.

ENVELOP.—A. G. GROETZINGER, care of American Express Co., Pocatello, Idaho. The invention relates to envelops for letters or other matter which it is desired to protect against injury and against examination during transit, and the main object to provide an envelop which is adapted to be used repeatedly although sealed in each use, no injury being inflicted on the envelop itself in these repeated uses other than the wear due to handling.

MIXING SLAB.—A. SHORROCK, Kimball Block, 68 Main St., North Adams, Mass. In the present patent the invention has reference to dental mixing slabs whereon it is desired to mix certain materials at a predetermined temperture, and the main object thereof is to provide self-contained means in such slabs for determining the temperature therof.

FABRIC BOLT BOARD.—C. K. BAUMAN, Hotel Biltmore, New York, N. Y. This invention provides a board having relatively rigid permanent side edges and relatively fragile removable sides for preventing the collapsing of fabric wound on said board; and reduces the cost of construction and lightens the weight of said board.

VENTILATING CHIMNEY.—G. T. BELL, Buckeye Lake, Ohio. This invention relates to a chimney having means whereby to ventilate the structure in connection with which the chimney is employed and more particularly it relates to a chimney involving an inner and an outer series of tiles, the inner tiles defining a flue, or flues, and the two series of tiles bring separated to produce air circulating spaces in the chimney at the sides of the flue.

METHOD OF IMPREGNATING WOVEN BELTS AND CONVEYING BANDS.—H. W. ANDERSEN, Sortebrodretorvet Nos. 19-21, Odense, Denmark. The invention comprises a process of treating textile belting, consisting in first impregnanting the web with a solution of asphalt and then coating the web with a layer of balata; and the method of preparing textile belting consists on treating the same with an asphalt solution and a rubber-like vegetable gum.

Hardware and Tools

DOOR LOCK.—H. REIN, 117 W. 87th St., New York, N. Y. This improvement provides a door lock comprising a slidable bolt having a composite point or end adapted to engage with the lock plate on the door jamb, and of such a nature that it is impossible for the door to be opened surreptitiously by the use of a jimmy or the like.

COIN CONTROLLED LOCK.—A. F. LEELER, care of The Sanitary Toilet Co., 50 Church St., New York, N. Y. The improvement pertains to locks and particularly to an improved coin controlled lock and has for an object the provision of an arrangement whereby the lock may be opened once from one side upon the insertion of a coin and also opened once from the opposite side by reason of the same coin.

NOZZLE.—A. W. LISSAUER, care of E. Horwitz, 115 Broadway, New York, N. Y. This invention relates to nozzles for generating a spray of liquid which is finely divided, whereby the nozzle is particularly adapted for humidifying air. It provides a nozzle which offers least resistence to flow therethrough, which will not clog, and with which a maximum amount of liquid can be delivered in a finely divided state with a minimum of initial pressure.

WRENCH.—M. A. RICE, 908 W. 36th Place, Los Angeles, Cal. With this invention Mr. Rice overcomes the tendency to lost motion which obtains in the ordinary adjustable wrench and the tendency of the parts to work loose after the wrench has been used some time and he accomplishes this result without any change in the stock or jaws of adjustable wrenches now on the market, the only charge being in the screw-threaded jaw adjusting means.

MOUSE AND RAT TRAP.—W. H. JACKSON, Sterling, Kan. One of the principal objects of the invention is to provide a mouse and rat trap in which provision is made for the safety of children, cats, dogs, chickens, and other animals, so that the trap may be set in places ordinarily frequented by them without danger of resultant harmful injury.

Heating and Lighting

HEATER.—C. W. HOPES, 4 Smith St., Glens Falls, N. Y. This invention provides a heater more especially designed for use in heating houses by steam, or hot water, and arranged to provide a large heating surface in a comparatively small space, to allow expansion and contraction of each individual section, to reduce the radiation of heat into the room in which the heater is located to a minimum, to allow of storing a large amount of fuel in the magazine, and to permit of feeding the fuel in desired amounts to the grates.

GAS PRESSURE REGULATOR.—B. M. CATTERMEIR, California, Mo. The invention relates to means for automatically controlling the supply of gas in the degree of use and is an improvement over the form shown and described in Letters Patent No. 1,177,314 formerly issued to Mr. Cattermeir. When the gas pressure is excessive the liquid in one tank is forced into the other and the float is permitted to descend correspondingly, thereby partially closing the needle-valve and reducing the gas supply and, when the pressure is reduced, the float again rises and opens the needle-valve.

Household Utilities

FRYING PAN.—G. EPPRECHT, care of National Silk Dyeing Co., Allentown, Pa. This improvement relates to frying pans and the like, and the main object thereof is to provide such a utensil wherein a constant and adequate supply of fat is insured to prevent scorching the food being fried, regardless of the deviation from horizontal of the bottom of the pan.

COFFEE MAKING APPARATUS.—A. MINTZ, 206 E. 5th St., Manhattan, New York, N. Y. The purpose in this case is to provide an efficient coffee-making apparatus in which the coffee-pots are heated by water confined in a jacket at the bottom of the boiler and which water is caused to circulate about the coffee-urns and maintain the same hot.

SHADE AND CURTAIN FIXTURE.—A. KOVACS, Address W. L. Voss, Harvey, Ill. This window fixture is adapted to support a shade roller, a curtain pole and curtain rods, and includes brackets adjustably supported to adapt them to conform to windows of various widths. The invention provides clamp means for adjustably securing the brackets to a co-acting base; and provides means on the bracket to support curtain rods in addition to a shade roller.

FOLDING CHAIR.—C. L. CRAIG, Washington Court-House, Ohio. The present invention relates generally to folding chairs and more particularly to a folding chair of the type described and claimed in Mr. Craig's former patent No. 1,129,793, the object of the present improvements being to provide a chair of this type so constructed as to be substantially non-tipping in use. Mr. Craig has invented another folding chair of such nature and design as to be unsusceptible of ready forward tipping so that a person's weight may with perfect safety be placed upon any part of the chair seat.

Machines and Mechanical Devices

CURRENT MOTOR.—C. C. COOK, Howard, Pa. This invention relates more particularly to an arrangement the main object of which is the provision of means whereby to do away with the necessity of transverse dams, and thus enable the erection of the motor at any point within a stream without encroaching upon the riparian rights of others.

DERRICK.—G. H. MILLER, Monticello, Me. The inventor provides a manually operated derrick or lift designed to be attached to a wagon or sled, or other vehicle, whereby heavy objects may be loaded and unloaded with convenience and comfort. He provides a derrick or lift which is extremely simple, durable, efficient and inexpensive to manufacture.

WEIGHING SCALE.—A. S. DYSART, Navy Yard, Portsmouth, Va. An object of the present invention is to provide a scale totally devoid of resilient springs, and in lieu thereof to provide a member immersed in a liquid, the buoyant effect of the liquid upon the member supplying the reactional force for the counterbalancing of the object to be weighed.

ORE SEPARATOR.—G. HERING, Boston Post Road, Larchmont, N. Y. Among the objects

(*Continued on page 358*)

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PATENTS

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Strategic Moves of the War, March 29, 1917

(Concluded from page 344)

successes on the part of the Allies, the withdrawal of the German forces to the north of Arras must be under consideration, so that a new linem ay soon be established there from Armentieres through Lille and Douai connecting with the present German left wing at or near Cambrai. With the armies in such close contact the next few days will no doubt furnish some interesting developments.

While all eyes are centered on the happenings on the western front, it will be well to watch Mesopotamia, where events of great importance are taking place The Turkish forces here that have been operating in Persia and between the Persian border and the Tigris are almost surrounded. The British forces are now on both banks of the Tigris near Djibarra or Samara. Dispatches from Petrograd report that Russian detachments pursuing the Turks in Persia have entered the vilayet of Mosul; these detachments have come from Sakkiz and will close the exit to Mosul. Further south the British forces are advancing up the Tigris toward the Mosul district, while Russian columns pushing west are coming from Kermanshah. It looks now as if it were a free-for-all race of the British and Russian forces which should reach, first Khanikin, then Mosul. A junction between these armies is the forecast; and, as the Turkish troops are cut off from escape in any direction, they will be forced to surrender. Such a disaster would undoubtedly be a vital blow to the Ottoman Empire.

The Manufacture of a 16-inch Gun

(Concluded from page 346)

over 70 feet long in the rough, is placed in a vertical furnace built of steel and lined with refractory material, where it is heated to the required temperature by means of gas. The heating furnace is then opened as shown in the back of our illustration, and the tube is picked up by a gantry crane, brought over a cylindrical tank of oil, and lowered therein, the process being carefully regulated so as to obtain the desired hardness in the tube.

Aluminum Coated Iron Castings

COATING iron with aluminum is a distinct advantage in that it affords a surface equal to that of regular aluminum dishes, but much cheaper, in that aluminum has advanced to nearly 65 cents per pound when before the war it was around 20 cents. A new method for accomplishing this successfully is reported as follows: The iron article to be coated is first galvanized or tinned and is then immersed in molten aluminum at about 700 to 800 degrees Centigrade. During this immersion the surface is swept by steel brushes The tin or zinc then passes into the molten aluminum while the aluminum replaces the tin or zinc on the iron surface. The article is then treated in two or more such aluminum baths, but the greater part of the tin or zinc is kept in the first bath. The aluminum adheres so well to the surface of the iron that it is claimed that it will not come off, tarnish, nor corrode.

Nothing New Under the Sun

THE *Journal of Industrial and Engineering Chemistry* of the American Chemical Society gives in its February number the "Report of the Committee of Chemistry of the General Society of the Friends of Industry, New York, October 26, 1831." It is a remarkable document and reads as though it had been prepared by a committee of to-day. A survey of the native chemical materials of the United States is given (east of the Alleghenys), as well as the effect of the European wars on production, the need of this country to be self-contained, the need of raw materials free of duty if they are not to be had in this country and the requirement of adequate tariff duties on wares that may be produced here. The disposition of European merchants to dump manufactured goods in the United States when industries begin is fully explained and the way the purchasers are squeezed by high prices when production ceases is set forth with skill and conviction.

HUDSON SUPER SIX

How Hudson Solved the Gasoline Problem

Now Furnished on the New Light Super-Six

The gasoline saver is one more new invention of the Hudson Super-Six.

It was shown for the first time at the New York Automobile Show in January. Now most all Hudson dealers are showing the new cars equipped with this and ten other important new features. The gasoline saver is the only new feature shown on automobiles at this year's shows.

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Hard starting and wasteful gasoline consumption due to cold weather and the low grade gasoline are overcome. Radiator and hood covers are not needed on the new Hudson Super-Sixes even in the coldest weather.

This device has been in use on hundreds of Hudson Super-Sixes during the coldest winter weather. Its effectiveness has been proved. It is as easily operated as the damper on a stove.

Low grade gasoline gives low mileage and is wasteful and harmful to the engine, unless the motor is operated steadily at high temperature.

Primer Insures Easy Starting

In zero weather, even at 20 below, the new Hudson Super-Six motor starts. The primer is another new feature of the new Super-Six.

On the new cars there are also other worth-while features you should see. There is the new plaited upholstering, more attractive door fasteners, hard rubber handles, an improved body finish and other details you can see. And then we have made many improvements in the building of the car. The car that last year won every worth-while record is a much better automobile now because we have learned to build them better.

We made those records of endurance for acceleration and speed with cars of the earlier production. No one has yet equaled anything we have done with stock Super-Six cars. And yet the cars we turn out today are infinitely better because of the increased skill and experience Hudson workmen have acquired in building the 25,000 cars that were produced last year.

Think What a Year Has Shown

Remember what was claimed for the Super-Six one year ago. Then we had only our own records to show—records proving the Hudson Super-Six the fastest stock car built.

We then had established only the 100-mile and the one-hour records for a fully equipped stock touring car. But since we have won the 24-hour record for a stock chassis, the Transcontinental Run both ways, the fastest stock chassis mile, and have outsold any other high grade car in the world. So if you want a fine car that out-performs any other car that is built your choice must be a Hudson Snper-Six.

Buyers Waited for Months

At this time last season orders exceeded our production by 8,000. At no time during the season were there enough Hudsons to go around. From this you can see what the demand will be this year. We are only producing 30,000 cars as against last year's 25,000 because we cannot build more and build them well. That is not a large increase. It shows, however, that if you want a Hudson you cannot afford to postpone buying. Unless you act now you may be like other thousands who will be disappointed this year because they could not get prompt deliveries.

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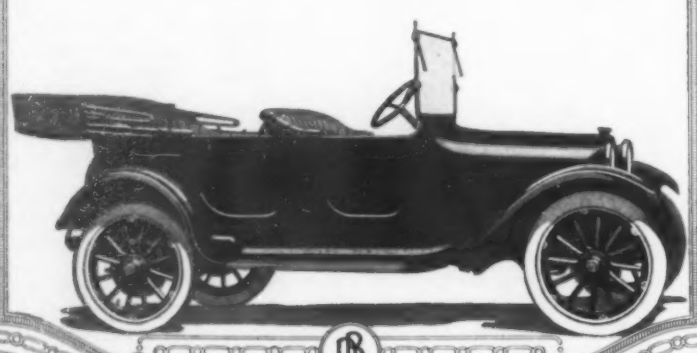

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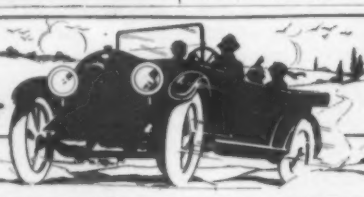

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RECENTLY PATENTED INVENTIONS

(Concluded from page 356)

of the invention is to provide a machine including a rotary device upon which the ores are received and separated as to size, weight or quality, the action being dependent upon the effect of gravity adhesion and in some particulars upon centrifugal force and magnestism.

REEL.—V. A. CEDERBORG, Box 765, care of C. T. Reel Co., Drumright, Okla. This improvement provides a reel adapted primarily to taking off drilling cables from oil wells and the reel is used when it is desired either to remove the cable as stated or when it is desired to change the ends of the cable. The cable may be rewound on the spool on which it was originally wound when sent from the factory.

PAPER FENDER FOR TYPEWRITING MACHINES.—B. A. SHAMMO, 106 W. 79th St., New York, N. Y. The inventor provides a device intended to be either an integral part of a standard machine or an attachment to be applied to a standard make of typewriting machine, so constructed and arranged adjacent the upper portion and back of the platen as to receive the upper end of the page or series of sheets being written upon and thereby guide the same well upwardly and rearwardly so as not to roll a second time beneath the platen.

TELEMETER.—F. N. JOHNSON, Public Works Department, City Hall, Little Rock, Ark. This invention provides an instrument for making linear or distance measurements which permits the use of various optical systems in such a manner that when two images, either partial or total, are reflected by mirrors or prisms into a telescope, sighting instrument, or directly into the eye and brought into coincidence to produce a clear image of the object viewed monocularly or otherwise, triangles will be erected with a properly calibrated part of the instrument and with the object viewed in such a manner as to establish a ratio permitting accurate determination of the distance to be measured.

Prime Movers and their Accessories

CARBURETER.—H. C. WELL, 1175 Wyatt St., Bronx, N. Y. This improvement provides a carbureter with a wick for conveyihg by capillary attraction a hydrocarbon to a passage where the air passing therefrom will entrain the hydrocarbon. It provides means for regulating the area of the air passage, as well as the area of another air passage through which air may pass to be subsequently mixed with the air carrying the hydrocarbon.

AUTOMATIC SAFETY CONTROLLER FOR PERMANENT WAY LOCOMOTIVES AND THE LIKE.—F. G. BARNES, Wynnum South, near Brisbane, Queensland, Australia. By means of this invention air or other fluid pressure brakes are automatically actuated should the train run past a specially devised warning obstruction which with or without a signal is set at "danger." At the same time the invention automatically registers the time at which the locomotive runs past such "danger" signal or obstruction, this registration being both audible and visible to the driver in the cab. Among other advantages is the provision of means for resetting the appliances after an operation.

RAILWAY TRAFFIC CONTROL APPARATUS.—B. F. WOODING, 48 South Willow St., Montclair, N. J. This invention provides means for controlling railway traffic in accordance with roadbed characteristics; provides members of the rolling stock of a railway equipment with apparatus operable from the roadbed to be normally operated when said members are traveling at predetermined speeds and abnormally operated when the members are moving at other than said predetermined speeds; provides means manually operated for releasing control of the track equipment; and provides a track equipment which may be varied in its effect upon the apparatus carried by the moving members to multiply the variety of effects on the operation thereof.

Railways and Their Accessories

CAR SEAL.—P. SCHMITZ, Cowletz Prairie, Winlock P. O., Wash. The seal is for attachment to freight cars and the like, whereby the goods therein cannot be tampered with or a fraud committed without detection, and to this end the invention includes a main casing in which is inclosed and locked a part of an identification strip, the other part being detached before the seal is locked, and separately forwarded to the same destination as the goods.

AUTOMATIC SAFETY SIGNALING AND BRAKING DEVICE FOR TRAINS.—J. F. McCOY, 170 India St., Brooklyn, N. Y. The invention provides a braking mechanism which when operated by a trip connected with each semaphore or signaling device will necessitate the engineer getting out of his cab and setting the trip device so as to close the auxiliary train line pipe in order to release the brakes and permit continued travel of the train, thereby preventing the engineer from rendering the device inoperative when once actuated, from the throttle lever or brake valve or mechanism associated with the air brake system, and rendering the mechanism tamper-proof and efficient in use.

Pertaining to Recreation

TOY CAP PISTOL.—J. ANDERSON, 421 56th St., Brooklyn, N. Y. The pistol comprises a tubular barrel and a weight slidable therein toward or against an anvil member for exploding the paper cap, the action being practically automatic, no springs or other movable parts being required for manipulating the weight other than the impulse given to the weight by the swinging of the pistol.

MECHANICAL TOY.—J. J. SABIN, Coupeville, Wash. The invention provides a toy adapted to be arranged on the hood of a motor vehicle, weather vanes, cupola or the like, wherein the representation of a figure, as for instance a man, is mounted to rotate on a vertical axis, wherein the head is mounted to turn with respect to the body and wherein the arms are provided with blades and they are mounted to rotate on an axis transverse to the turning movement of the head and the rotation of the body, and wherein the arms during their swinging movement move the head from side to side, the head facing each arm during the downward movement of the arm.

GAME.—W. R. CHRISTIE, 107 Vanderbilt Ave., Brooklyn, N. Y. This invention provides a projecting device which may be readily held in any place and caused to strike a ball or other object for projecting the same. The device is arranged substantially in the shape of a cone but provided with a removable bar or cue limited in its movement but adapted to strike an article within said movement with different degrees of force according to certain adjustments of the parts.

Pertaining to Vehicles

SAFETY VALVE.—H. B. ASHELMAN and J. S. JOHNSON, Fargo, N. D. This improvement enables the valve to automatically give relief in the event that the pneumatic pressure within the tire exceeds a predetermined normal limit, so as to avoid excessive or dangerous pressure of air within the tire, no matter whether such pressure be due to the act of inflating the tire or accumulated by other means, for instance by expansion of air within the tire due to the application of heat.

VEHICLE TIRE.—M. VIERENGEL, 604 Van Buren St., Brooklyn, N. Y. This invention prevents total deflation of a pneumatic tire when punctured; avoids the inconvenience incident to the puncturing or leaking of pneumatic tires; prevents the disastrous loss of air incident to the puncture of the wearing shoe of a tire; and provides means for obtaining a maximum pressure of air in the tire.

COMBINATION SLEEPER-CARRIAGE AND GO-CART.—N. J. KROLL, 5511 Fifth Ave., Brooklyn, N. Y. This invention provides a go-cart and baby carriage of the sleeper type, arranged to permit quick and convenient converting of the go-cart into a sleeper baby carriage or vice versa, thus permitting the use of the vehicle by an infant for outdoor sleeping purposes and providing for use of the vehicle as a go-cart as the child is growing up.

DEVICE FOR CONTROLLING SHOCK—C. B. BILLINGHURST, 303 Dakota Ave., Pierre, S. D. This invention provides mechanism for use in connection with motor vehicles, of every character, for absorbing shock and jar resulting from the movement of the vehicle over the road, wherein an improved form of hanger connection is provided for interposition between the body and the frame of the vehicle, or between the frame and the axles of the vehicle.

MEANS FOR PREVENTING THE RAISING OF DUST BY MOTOR VEHICLES.—B. JONES and P. J. REES, respectively at 54 Gate St., Cwmgors Road and post office, Tairgwaith, Gwaun-Cae-Gurwen, Glamorganshire, Wales. This invention relates to the prevention of dust raising by motor vehicles and provides means which may be actuated by the motor of the vehicle, and serve to prevent the raising of dust by the vehicle wheels. The aim of the inventors is to nullify the tendency to create a partial vacuum behind the wheel, by the delivery of a counter-current of air.

VEHICLE WHEEL.—H. C. DAUPHINAIS, 815 7th St. S., Fargo, N.D. This invention consists in constructing a vehicle wheel in two sections, an outer or perimeter and an inner or hub section. Each of these sections is provided with a series of radially disposed and interspaced spokes, each series of said spokes being rigidly connected by ring-like members having formed therein guides for the opposite series of spokes.

Designs

DESIGN FOR A GIRL DOLL.—AMELIA MORSE, care of Rite Specialty Co., 35 W. 36th St., New York, N. Y. This design, No. 50,314 represents a round head doll with baby facial features, a bell-shaped body, straight legs and flat feet. The same designer has designed a boy doll No. 50,315 which comprises a figure with a round head and body, straight legs and flat feet, each of which parts bear attractive ornamental features. Her next design, No. 50,316 is that of a figure toy which has a round head and body, and round stumps for feet. The face is cat-like and and a heavy ring projects from the top of the head. The toy is ornamented with some unique apparel features. Another design No. 50,317 is that of a figure toy whose round face bears dog-like characteristics, the body is ball-shaped and the feet flat, while the ornamented points are few yet effective. Design No. 50,318 provides a figure toy with an egg-shaped head with animal ears in the center of the forehead. The expression is childish, the body is shaped like an inverted top and the legs are straight with flat feet. No. 50,319 represents a figure toy of boyish face, the round head crowned by a high hat. The body featurps are somewhat similar to the other rotund formed toys. No. 50,320 is the sixth and last of these Morse toy designs and represents a round-faced girl with a small hat, a bell-shaped body, straight legs and flat feet.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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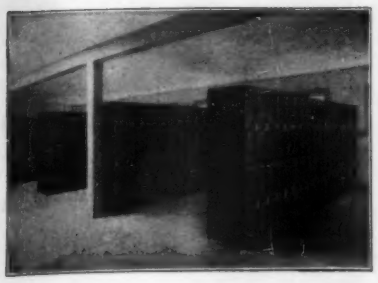

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GREENFIELD MASS., U.S.A.

What I Can Do for My Country

(*Concluded from page 352*)

the manufacture of these articles from the raw fiber can proceed well enough without the chemist. When it comes to war-time contracts, however, rigid inspection standards are at once imposed; and these, in so far as they apply to control by the manufacturer of the raw materials entering into this textile goods, must be of a chemical nature. No one but the chemist can tell the uniform maker whether the coat and trousers he proposes to make from a certain consignment of wool will pass. No one else can separate the supply of cotton or hemp into two classes, one of which can safely be used in making shirts or cordage, the other not.

The food chemist comes next. He occupies a far more important place in war than in peace. Far more canned goods must be prepared and their delivery to the consumer becomes a far more vital matter when failure means that he must go hungry because there is nothing else for him to eat. The prescription of a properly balanced diet from day to day is a matter for the chemist's attention. Finally, the national health is of so much more consequence than in normal times that there must be far more general inspection of foods before eating. In particular, the canned goods furnished for military consumption, and every drop of water drunk by soldier or sailor or industrial worker, must be certainly known to be free from disease germs and actual poison. The single item of canned goods, already mentioned, covers practically the entire range of human diet. To enumerate a few other items to which the food chemist's efforts must be turned would be to mention cane and beet sugar, pepper and salt and vinegar, yeast, flours, prepared fats for both eating and cooking. Both in their manufacture and in their dispensation all these call for the services of the chemist.

Similar to the work of the food chemist, but even more specialized, is that of the medico-chemist. Disinfectants and sterilizers, anesthetics and narcotics, sutures and tendons, must be prepared in great quantities for field and hospital use. Responsibility for seeing, before using these, that they are in usable shape, must rest with physician and surgeon. But the very delicate business of making them must proceed under the watchful eye of the chemist. He must also furnish the cruder disinfectants for general use, purifying agents for water, and unusually large supplies of quinine and other standard drugs.

We do not for a moment suppose that we have enumerated all the activities of a chemist that might be of value in times of war. An omission which occurs to us as we write is the rôle of the glass chemist in keeping up the supply of optical and hospital instruments; and there must be many others. But we have, we think, said enough to indicate that every chemist, whatever the field of his specialization, whether his work lies in the testing of materials or in the supervision of processes, can give better service behind than in the line of battle.

The danger, of course, is not we have not enough chemists. We have, and they are right now engaged in doing the very things we have set forth. The danger is that they will cease doing these things and try to do something else which is mistakenly looked upon as of more consequence.

If you are a competent chemist, nothing is of more consequence than that you should stick to your bench when war comes. If every chemist now engaged in any portion of the field which we have so roughly indicated will stay right on his job; if every man who has the knowledge or ability to run one of these jobs, but who has been doing something less essential, will change his employment, temporarily, looking upon himself as a volunteer in behalf of a short war and a successful one, the chances of having a short and successful one will be greatly enhanced. In no other way can the United States "do its bit."

"Life Insurance Without Agents is a Distinct Public Service"

Postal Life Method Sanctioned by the United States Supreme Court

Timely Talk on a Vital Subject

(*Scene: Pullman Smoking Compartment. Judge Kirkland and Lawyer Roberts continuing a conversation begun at dinner.*)

Judge: "Well, this business of selling direct-by-mail throughout the country is surely very popular with the public."

Lawyer: "Yes, but some of my clients say that in the interest of local merchants the States ought to find some way to check it."

Judge: "I don't see why they should check it or how they can do it. Selling merchandise is an interstate business. I can sell and you can buy in the best market wherever it is. What can any State do about it?"

Lawyer: "You're probably right, I'll admit. The States can't very well put the 'kiboash' on legitimate interstate business."

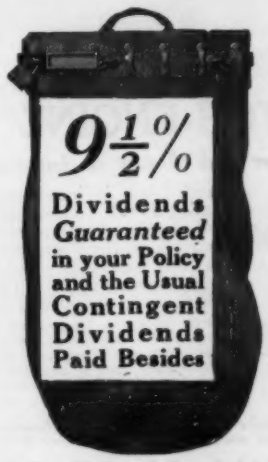
Judge: "Certainly not. The States cannot hold up arbitrarily any direct-by-mail transaction, such as the payment of life-insurance premiums by mail."

Lawyer: "How's that?"

Judge: "Policies are written for people, 'direct,' all over the country, and have been for years. The United States Supreme Court has decided unanimously that life-insurance premiums on such policies are exempt from State taxes. The usual license-fees and charges also do not apply to direct-by-mail transactions. All this helps policyholders."

Lawyer: "Oh, you refer to the Postal Life?"

Judge: "Yes, that Company hasn't any agents and never has had. The applicant deals direct, personally or by letter. The method is good common sense as well as sanctioned by law."



Lawyer (laughing): "Guess you're right. I wrote the Postal once myself just to find out how the Company did business, but never followed it up."

Judge (laughing): "I go you one better; I not only wrote them, but took a policy nine or ten years ago and have carried it ever since."

Lawyer: "How's the cost?"

Judge: "Lower than in other companies for the same kind of insurance—legal reserve—and besides that they give me a free medical examination each year just so I can keep in trim."

Lawyer: "That's pretty good. You live in Idaho and deal with a New York company by mail. Did you ever look the Company up?"

Judge: "Only to know that it is chartered and licensed by New York State, whose laws are very strict, but I called on them when I was East. They're now in their new building on Fifth Avenue."

Lawyer: "So I hear. Believe I'll write them to figure on a policy for me."

Judge: "Don't think you could do better. Life insurance without agents is a distinct public service. That point is made, and I think it is a good one, that the Company is subject to the United States Postal Authorities. The Postal Life simplifies the business, saves you money, safeguards your health and will treat you right in every way. I'd take another policy myself if I hadn't passed the age limit."

That tells the story. Thoughtful insurers like Judge Kirkland take policies with the Postal and not only hold on to them but are disposed to take new insurance, while those like lawyer Roberts, who at first write out of curiosity, at last find they can save money by taking a Postal Policy, and they do it.

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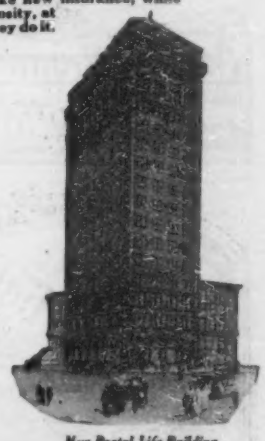

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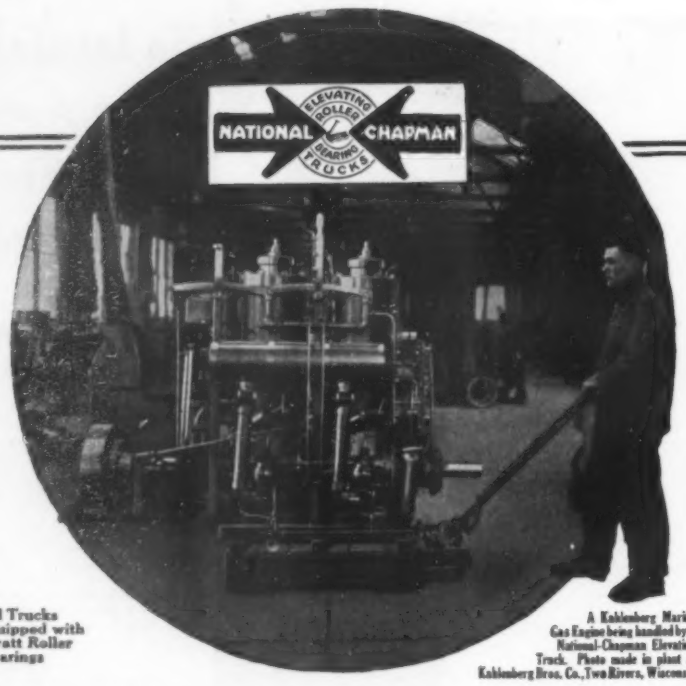

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A Kahlenberg Marine Gas Engine being handled by a National-Chapman Elevating Truck. Photo made in plant of Kahlenberg Bros. Co., Two Rivers, Wisconsin

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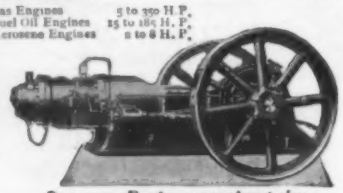

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National Forest Enlarged

ACTING under the authority of a special Act of Congress approved September 8, 1916, the President has, on recommendation of the Secretary of Agriculture, signed a proclamation adding approximately 50,000 acres to the Whitman National Forest, Oregon. The lands involved are situated on the divide between the John Day, Powder, and Burnt rivers, in East-central Oregon.

Over 4,000 acres consist of timber lands which were included in patented entries. As the result of suits brought by the United States, the patents for these entries were canceled by the courts because they were acquired through fraud or mistake, and the lands were returned to Government ownership. The canceled claims carry a total estimated stand of nearly 46,000,000 feet, board measure, of timber.

Much of the other land included in the addition is privately owned. It consists largely of cut-over timberland, on which the timber growth is rapidly reproducing. One portion of the Act of Congress authorizing the addition provides especially for the exchange of Government timber for privately owned lands in the Whitman National Forest which may be chiefly valuable for the production of timber or the protection of streamflow. Several applications for exchanges of this character have already been submitted.

The Most Active Classes of Inventions

THE following classes of inventions have been reported by the examiners as the most active during the period from 1890 to 1917:

Circular looms;
Warp and Weft replenishing for looms;
Fiber (cotton and wool) cleaning and manipulation;
Automatic continuous warpers and winders;
Electric furnace refining of steel, recovery of metals from ores and production of special alloys;
Storage battery;
Electric heating appliances;
Electrification of railroads and long distance lines;
Train control and motor control;
Polyphase and high voltage systems of electric transmission;
Electric-dynamic phase transformers;
Wireless control of torpedoes, searchlight and gun pointing;
Electric motors including split phase, induction and alternating current commutator motors;
Gear-cutting;
Aluminum extraction;
Metal rolling;
Resilient tires and wheels;
Automatic screw machines;
Railway draft appliances (safety couplers, etc.);
Projectile making;
Acetylene gas lighting;
Typewriters and combined typewriter and adding machine;
Illumination, including indirect, projector, miner's daylight and flash lamps;
Reinforced concrete structures, including houses, bridges, piles, posts, wharves and shore protection;
Steel car structures;
Stone working machines;
Coal mining machines;
Oil well drilling machines;
Confectionery, including candy pulling, ice cream cone making, etc.;
Vehicle tire manufacture;
Linotype machines;
High speed rotary printing press;
Wrapping paper feeding and folding machines;
Duplicate writing or printing machines;
Can making and seaming machines;
Wire fence and fabric making machines;
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Heavier-than-air flying machines;
Pneumatic hammers and stone drills;
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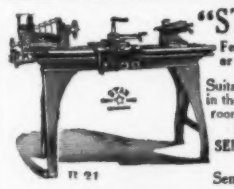

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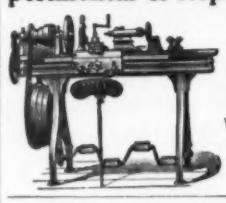

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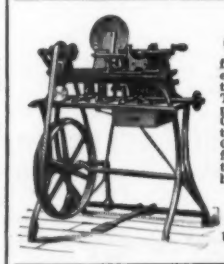

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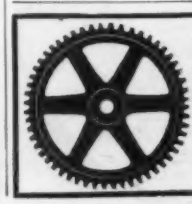

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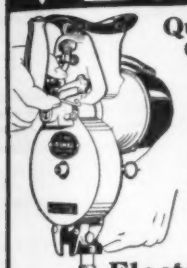

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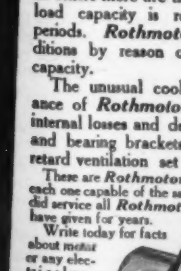

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Third rail underground conduit systems;
Railway block signaling.

Why the Average American Dies at Forty-three

By R. W. LOCKWOOD

THE presidents of life insurance companies with perhaps twenty billion dollars insurance on the lives of Americans, recently met in convention at the Hotel Astor in New York, and in their discussion brought out some of the reasons why the average American dies at about forty-three years of age.

According to the press reports, Mr. E. E. Rittenhouse, Commissioner of Public Service and Conservation of the Equitable Life Assurance Society, said; "The average American would not think of mixing bricks or scrap iron or gravel with the fuel for his furnace, yet he feeds his stomach with all sorts of tasty junk, much of which cannot be fully digested. . . he is seriously overstraining his heart, arteries, kidneys, nerves and digestion, as the rapidly increasing death rate shows."

This statement from such an authoritative source—from a man who makes it his business to study both vital statistics and the causes behind them—sounds a warning which should be heeded by every man and woman.

Indeed, there is no longer a doubt among intelligent people that many of the foods and combinations of foods which we are most accustomed to eat are the direct cause of much sickness.

Yet how few of us heed the early warnings of illness, such as acid-stomach, fermentation, or constipation. I venture to say that nine out of ten persons suffer to a greater or less extent from one or more of these three symptoms, which are in many cases the forerunners of more serious sickness.

Stomach medicines and laxatives are plentiful, but of what avail are they? The only thing that a stomach medicine can do is to temporarily neutralize the extra amount of acid in the stomach, because it is *stronger* than the acid. And this injures the stomach, usually bringing the acid back worse than it was before. A laxative is just as bad, if not, a little worse; not only is is effect temporary, but all laxatives are habit-forming and are required in ever-increasing doses.

If neglected, a simple case of acid-stomach may lead in a short time to fermentation with gas, and constipation. The fermenting food forms poisons which are absorbed into the blood, causing auto-intoxication, nervousness, mental depression, and a host of other unpleasant symptoms.

Is it any wonder that the officers of large insurance companies sound a warning against the evils of wrong eating?

* * * * * *

But just as wrong eating is the cause of 90 per cent of common illnesses, so will correct eating create and maintain both bodily vigor and mental energy. And by right eating I do not mean freak foods—I mean just good every-day foods properly combined. In fact, to eat correctly, or follow a course of Corrective Eating it is not at all necessary to upset your table.

Eugene Christian, the well-known food specialist, has proved the efficacy of Corrective Eating in thousands of cases. Entirely without the use of drugs or medicines, men and women suffering from almost every conceivable non-organic ailment have been returned to health and vigor by following his simple directions in regard to their eating.

* * * * * *

In a recent talk, with Eugene Christian he told me of several interesting cases which had recently come under his care. One was that of a woman prominent in Woman Suffrage work in New York City. She had come to him with stomach and intestinal fermentation and gas, auto-intoxication, mental depression and anemia, vertigo, and threatened heart failure. She was very much overweight when she commenced, but reduced her weight thirty-seven pounds during the treatment. He showed me a letter she had written him afterward, in which she said:

"I am sure you will be gratified to hear that I continue to improve—it seems sometimes that I must have been made over, and it is difficult to remember that less than eight months ago I was a feeble old woman depending upon daily doses of strychnia for what little strength I had. When I came under your treatment, I weighed one hundred and ninety-seven pounds, was hardly able to walk, and was subject to most serious heart attacks upon the slightest exertion. And now I am so well, so strong, that my family and friends maintain that it is a miracle which has restored me to strength and vigor of life—certainly in my case the cure is most remarkable because of my sixty-seven years."

Another was a well-known minister who had been out of his pulpit for twenty-two months, unable to preach or conduct the simplest service. He was about twenty-five pounds under-weight, anemic, nervous, had superacidity, and could not assimilate his food; and his heart action was very irregular. He had gradually declined for two years although treated by one of New York's leading physicians. Three months after he placed himself under Eugene Christian's care, he preached the first sermon he had been able to preach in nearly two years. This was over three years ago.

He has gained about twenty-five pounds in weight and since has not missed a day from his arduous clerical work. He has steadily gained in strength and vitality and is to-day healthy and athletic.

* * * * * *

But Eugene Christian's own case is perhaps the most interesting of all, for it shows how he discovered the beginnings of the methods which he has since pursued so successfully with others—methods of selecting and proportioning one's meals so as to overcome conditions brought about by wrong eating.

Twenty years ago he was at death's door; for several years previous he had suffered all the agonies of acute stomach and intestinal troubles, until his doctors—among them some of the most noted specialists in the country—gave him up to die. As a last resort, he commenced to study the food question himself. As a result of what he learned, he succeeded in literally *eating his way back to health* without drugs or medicines of any kind and in a remarkably short space of time.

Eugene Christian is to-day nearly sixty years old—or shall I say young? For he has more vitality, more ginger, more physical endurance than most youngsters in their teens. During the past fifteen years he has not had even so much as a cold.

* * * * * *

Since the remarkable success of Eugene Christian has become known, people have sought his advice in such rapidly increasing numbers that he has found it necessary to put his methods in printed form. He has written a series of 24 Little Lessons which tell you exactly what to eat for health, strength and efficiency.

These lessons contain actual menus for breakfast, luncheon, and dinner, including corrective menus for almost every condition of health and sickness from infancy to old age, for all occupations, climates, and seasons.

With these lessons at hand it is just as though you were in personal contact with this great food specialist, because every point is so thoroughly covered and so clearly explained that you can scarcely think of a question which isn't answered. You can start eating the very things that will help to produce the increased physical and mental energy which you are seeking the day you receive the lessons. And you are quite likely to feel some results after your very first balanced meal.

If you would like to examine these "24 Little Lessons in Corrective Eating," simply write the Corrective Eating Society, Inc., Dept. 1154, 450 Fourth Avenue, New York City. It is not necessary to enclose any money with your request. Merely ask to have the lessons mailed for five days' trial with the understanding that you will either send the small price asked, $3, or remail the books.

Merely clip out and mail the following form instead of writing a letter, as this is a copy of the official blank adopted by the society, and will be honored at once.

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(14207) C. J. S. asks: Kindly answer following in Notes and Queries column of SCIENTIFIC AMERICAN. We have the files for years as well as the weekly issues here in our library, but I cannot find references to these questions. I have read the articles by Hassard on the making of a 4½-inch reflector, and Mellish's on a 16-inch reflector, and I have made satisfactory specula, 6 inches, and made very satisfactory equatorial mountings with circles for a 4-inch reflector and a similar one for a 2¼-inch reflector, and Mr. Mellish made me a 12-inch mirror, which I have satisfactorily mounted. I tried to get Ritchey's work on "Reflecting Telescopes," but the Smithsonian Institute returned order and check, saying they had no further copies of the work. I have not had real satisfaction in silvering, and have read the article on silvering in eleventh edition "Encyclopedia Britannica" (Brashear's Cold Method), but it is obscure in some ways. So you can please answer in the Query column: 1. Which is considered the best method of silvering? In art in "Encyclopedia Britannica" statement is made, "dilute, mix, pour on plate," but does not say how much to dilute. What dilution does this signify? 2. In Cassegrainian mirrors, is hole drilled or cast when disc is cast, or after grinding or polishing? How can such a hole be drilled in a 12-inch disc? Could a 2-inch hole be safely chipped out? 3. Works on telescopes state "more light is saved (or all of it) by using an internal reflecting prism instead of a flat." Seems to me no light rays can reach the speculum through the totally reflect-surface of the prism. 4. Likewise why is "best part of mirror cut away" in Cassegrainian telescope, when with using flat in Newtonian form or the convex mirror in the Cassegrain, or (seems to me) even with a prism in Newtonian form, these parts cut off the rays that would strike the "best part of mirror," why the objection to the hole, flats, etc., when with any of these forms the central part of mirror is thus out of commission? 5. In a Herschellian form, is not the distortion of the image very slight if mirror is of very long focus? Could a flat be placed where eyepiece is ordinarily used in this form, so as to reflect rays down to "eye end." "Brachy" telescope uses a convex mirror thus, but I have heard nothing of the details or the results gained. 6. The average polished plate glass has usually a very beautiful surface. Is plate usually true enough for a flat—"a true optical plane"? 7. In the last polishing of a mirror, is not a chamois with rouge on it a better medium, placed over the pitch coat, than wax, or than the pitch alone? 8. Can you give a brief description of the Foucalt test? No account of it can be found in "Encyclopedia Britannica," nor in any work I have been able to get my hands on. I know how to have the pinhole, the mirror, and knife edge, but is the lamp moved, or the speculum turned, or the knife edge moved to get the point of pencil of rays equidistant from all parts of mirror. How far is speculum usually placed from lamp and knife edge? Can burnishing without resilvering usually be done to good effect? A. 1. Probably there is no method of silvering a mirror which can be pronounced the "best" method. Most formulas yield good results when carefully followed. Doubtless Dr. Brashear will give you advice regarding the application of his method if you will address the John A. Brashear Company, Pittsburgh, Pa. In following a formula, where it simply calls for a dilution, such a dilution must be intended as will give the proper quantity for the area to be coated. You will find an excellent description of the silvering process in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1991. We reprinted the Ritchey paper on the Reflecting Telescope and the Making and Testing of Optical Mirrors, from the Smithsonian "Contributions to Knowledge." It is contained in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1512-1513-1514-1515-1516-1517. These numbers can be had from the H. W. Wilson Company, White Plains, N. Y., for 10 cents each. 2. We cannot say whether holes are ever cast in optical glass. Should you wish to drill a glass plate, you will find clear and practical instructions in our "Cyclopedia of Formulas," price $5.00 postpaid. The great mirror, 73 inches diameter, of the new Canadian telescope has a hole in it over 10 inches in diameter. 3. A totally reflecting prism intercepts only a small portion of the light which enters a 12-inch telescope tube. It has no other effect upon the seeing. It, however, transmits much more light than a plane mirror reflects. It is much better than a plane mirror for changing the direction of a beam of light. 4. The small hole necessary to transmit the beam in the Cassegrainian form of telescope does not seriously reduce the amount of light, but with it the instrument can be handled like a refracting telescope, as no other form of reflector can be. 5. We see no difficulty in using a mirror in the place of the eyepiece in the Herschellian reflector, and sending the light down to the lower end of the tube, but you must then submit to the loss of light from the small mirror by reflection. 6. We do not think ordinary plate glass has a sufficiently true plane surface for use with high powers and we should expect the disks of planets, etc., to be distorted if plate glass were used for a mirror. 7. If chamois were better than the forms now used the makers of telescopes would have found out the fact and would be using it instead of the wax form. The fibers of chamois leather would probably leave marks on the glass. 8. We regret to say that we are not able to give any details of the Foucault test. We have had no experience in that line of work. 9. The old silver is removed from a mirror with nitric acid, before resilvering. We should advise you to seek the advice of makers of reflecting telescopes as to the finishing.

(14208) J. F. S. asks: 1. In regards, to the sinking of the "Titanic"; did this ship sink clear to bottom? If it did not, please explain the cause of its not sinking to the greatest depth, and if it did sink to bottom please explain cause of its doing so. 2. What is the greatest depth a submarine can submerge with safety? At what depth was the "Deutschland" lying when it was submerged in the English Channel for a couple of days? What is the greatest depth a boat similar to the "Deutschland" could sink? 3. How long would it take a current of electricity to pass around the earth if it were possible to run a wire around for that distance? A claims that the resistance would hinder the speed of the impulse and by so doing would take several seconds for it to pass around the earth. B claims that all electricity travels at the same speed and if a large enough impulse were started into the wire that it would reach the other end instantly, because he says that all currents travel with the same speed, and if it reached there at all it would travel the whole distance with the same speed that it would travel 100 miles and considering that electricity travels at the speed of 288,000 miles per second B claims that it would traverse the globe instantly. Who is correct? A. 1. The "Titanic" went to the bottom quickly and swiftly so soon as she filled with water. The reason is that she was heavier than the same bulk of water. Water is compressed very slightly by pressure and s only about 1/5 heavier at the bottom of the deepest places than at the surface. The pressure of the water has no effect on a sinking body. We fall through the air very swiftly, and the pressure of the air is enormous on us, several tons. We move through it with no thought of its pressure. The reason is that the pressure is equal in all direction and so does not prevent our motion through it. It is the same with water. 2. The submarine which sunk in Honolulu harbor was found in a little over 300 feet of water, as we remember it. A submarine could not withstand this pressure. Its plates are not thick enough to do so. We do not know the depth to which the "Deutschland" sunk. The air in a submarine is compressible and the plates would be bent in with the pressure of the water outside, so that the boat would collapse with a pressure sufficient to bend the plates. 3. It would take several seconds for a current of electricity on a wire to flow around the earth We do not know the exact time. The number of miles you give, 288,000 per second, was determined by Wheatstone many years ago, and later work has led men to think the number not correct. Electric waves through space are believed to travel with the speed of light, 186,300 miles per second. There is no known motion faster than this. It is the swiftest known in the universe. "Ganot's Physics," 18th edition, page 858, has this statement, "There is no distinct meaning to be attached to the expression 'velocity of electric transmission,' since it depends upon so many conditions, such as electromotive force used, length of line, capacity, inductance, and resistance of line per unit of length." Electricity cannot flow in an instant to any considerable distance over a wire.

(14209) R. H. S. asks: Would you be so kind as to enlighten me on the question below? Several men have been trying to tell me that a fan type vacuum cleaner *is not* a *vacuum* cleaner, but a suction cleaner. That a vacuum cleaner is a machine that has a pump to it. I claim that to create a suction you must *first* create a *vacuum*. The fan in my opinion a fan type machine creates a vacuum just the same as a pump, only a different principle . Can a suction be created without creating a vacuum? Are not suction and vacuum the same thing? A. All forms of cleaners work by producing a partial vacuum in the tube and the air pressure on the outside pushes air and dirt up into the bag or box of the cleaner. A fan sucks air out from behind itself and so reduces the air pressure there and air blows in to take the place of the air sucked out by the fan. A pump takes air out in the same manner and the air outside pushes in to take the place of the air pumped out. Either way the taking of air out reduces the pressure and this produces a partial vacuum. Any form of machine which takes air out of the machine and causes air to rush in and carry dirt with it is a *vaccum* cleaner.

You are quite right that suction operates by first producing a partial vacuum. A boy sucks cider through a straw by sucking the air out of the straw and the cider rises to fill the place from which the air has been sucked out. Of course it is the pressure of the air outside pushing down on the cider outside the straw which causes the cider to rise in the straw; but the vacuum is there truly. Suction may cause a vacuum but suction and vacuum have not the same meaning. Suction is an action. A vacuum is an empty place.

(14210) W. J. M. asks: Would you please give me the specific gravity of argon gas. A. The specific gravity of argon gas is 1.3778, the air being taken as 1. A liter at 0° C at sea-level in 45° latitude, and 760 mm. barometer, weighs 17.828 grammes.

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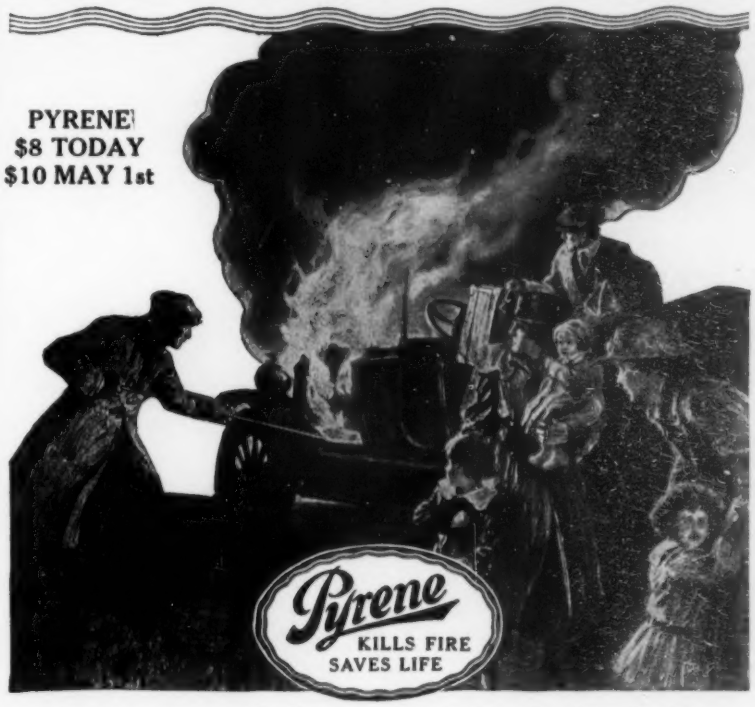

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J. P. MORGAN

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The first story of its kind ever published about Morgan

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Ice Cooled Bubbling Fountain

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A Scientific Solution of the Sanitary Drinking Water Question

Fifteen and one-half circulating coils of pipe in the cork-jacketed ice tank insure an ice-cooled sanitary drink to every employee.

Holds 75 Lbs. of Ice. ***Supplies 150 Persons***

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Manufacturing Equipment and Engineering Co.

136 Federal Street - Boston, Mass., U. S. A.

NEW BOOKS, ETC.

VOCAL ART-SCIENCE AND ITS APPLICATION. By Frank E. Miller, A.M., M.D. With a Foreword by Gustav Kobbé. New York: G. Schirmer. 8vo.; 291 pp.; illustrated. Price, $2.50.

This substantial work is particularly addressed to the vocal teacher, the physiological investigator, and the medical specialist; to these must we look for the coöperation that alone may lift voice culture out of the muddle into which it has fallen, and place it firmly upon established facts and principles. Ignorance masquerading as dogmatism is doing incalculable harm to our young singers, and Dr. Miller's sincere and significent labors can hardly be overestimated; he brings order out of chaos by delving down through effect to cause, replaces guess-work by knowledge, and builds facts into a harmonious whole that must be conceded the name of vocal art-science. Old basic principles are not attacked; the old ideas are simply enriched by the modern findings of anatomy, physiology and psychology. His own experience as singer and physician, with his access to noted artists and investigators, has enabled him to use his powers of observation to excellent effect in this full disclosure of the mechanism of voice and the automatic use of this mechanism as a medium of art expression. The work inaugurates a movement toward universal standardization of voice principles, and goes back of the mere muscle-sets involved, to seek knowledge in the light of their nerve supply, believing that an explanation of genius lies in the perfect harmony of the cerebro-spinal and sympathetic nervous systems. Unique illustrations enliven the text and point its lessons; altogether it would appear that Gustav Kobbé's designation of the volume as "epoch-making" contains as much truth as eulogy.

THE "MECHANICAL WORLD" POCKET DIARY AND YEAR BOOK. 1917. Baltimore: The Norman, Remington Co. 16mo.; 453 pp.; illustrated. Price, 35 cents net.

The thirtieth issue of this year book carries the usual notes, rules, tables and data of interest to engineers. The section on the steam engine has been revised to date with added notes on lubrication and anti-friction bearings, and there is a new section on the heat treatment of steel. An index discloses some seven hundred items of information illustrated by numerous small but clear cuts and diagrams; there is a judicious selection of tables, and blank leaves in the back of the book are arranged for a diary and for memoranda.

HANDBOOK OF ENGINEERING MATHEMATICS. By Walter E. Wynne, B.E. and William Spraragen, B.E. New York: D. Van Nostrand Company, 1916. 12mo.; 230 pp.; 113 illustrations. Price, $2 net.

Students of engineering will find here in compact and handy form the mathematics, both theoretical and applied, most useful to their profession; and not only the formulae, but also the underlying data and applications. All branches of the subject are dealt with, including differential equations, and while the work is addressed primarily to the student, there is no reason why the practising engineer should not avail himself to good advantage of the reference material that the little volume presents in so handy a form.

ARITHMETIC FOR ENGINEERS. Including Simple Algebra, Mensuration, Logarithms, Graphs, and the Slide Rule. By Charles B. Clapham, Hons. B.Sc. Eng. (Lond.) New York: E. P. Dutton & Co., 1916. 8vo.; 447 pp.; illustrated. Price, $3 net.

Those who hold, with the author, that existing text-books too lightly dismiss elementary principles, will find the fault remedied in this new work, that, discarding the purely academic, follows every principle with worked examples which embody actual problems of the laboratory, draughting room and workshop. Admirably combining the theoretical and the practical, the work aims also at economy of effort; these features should appeal to teachers in technical schools, while the clear detail of the work should commend it wherever a text for home study is desired.

FACTORY ACCOUNTING. By Frank E. Webner, C.P.A. Chicago: La Salle Extension University, 1917. 8vo.; 357 pp.; illustrated. Price, $2.75.

"Factory Accounting" is the sixth volume of the LaSalle course in higher accountancy, and has been prepared by a factory cost specialist. This branch of accounting has assumed a commanding position in the new industry, and now calls for recording that is not only systematic and comprehensive but also accurate and economical. The clear definitions and statements of the author, supplemented by charts, graphs and forms, go far toward simplifying a rather complex subject; while the intelligent beginner should find no difficulty in mastering the text, it may also claim the attention of the advanced accountant by reason of its up-to-date working methods and efficient technique. Practice is set forth under the general heads of organization, controlling records, industrial classification, and production elements.

HOW TO MAKE THE BUSINESS PAY. By Edwin L. Seabrook. New York: The Sheet Metal Publication Company, 1916. 8vo.; 200 pp. Price $2.

This work on business management is addressed to those who are in one of the various branches of building construction, and covers advertising, correspondence, securing reliable customers, cost of conducting business, bookkeeping, estimating, and efficient collection methods. Since so many men enter these trades as employees, and save until they have sufficient capital to establish a business of their own, they have little opportunity to learn the essentials of business management until its principles are forced upon them by costly losses and mistakes. Most of these errors could be avoided by the intelligent study of this treatise, which places contractors in touch with vital facts, suggests new avenues of development, and solves many of the common problems of everyday experience.

RANGE-FINDER AND SLOPE-CARD. Designed by Capt. C. R. Young, C.O.T.C., Toronto, Canada.

The range-finder is a small, opaque card of celluloid to which is attached a string fixing the distance at which the card is to be held from the eye. Along the upper edge is a scale which is superimposed upon the target, and below the scale is a diagram for determining the range without calculation; this consists of curves giving the width or height of the target in yards for any range up to 1,800 yards. The reverse side of the finder has instructions for its use, together with a table of approximate dimensions for familiar objects in the landscape; there is also a protractor by which the slope of the ground, or the height of any point above the observer's position, may be determined. An accompanying pamphlet gives detailed instructions for the use of both range-finder and slope-card, with typical examples and solutions. Capt. Young's device seems to offer various advantages that should enable it to find favor in military circles.

THE WORLD'S MINERALS. By Leonard J. Spencer, M.A., F.G.S. New York: Frederick A. Stokes Company, 1916. 8vo.; 338 pp.; illustrated. Price, $2.75 net.

The new edition of this authoritative work, beautified by more than two hundred accurate illustrations in color prepared under the direction of an expert from the British Museum and brought up to date by the inclusion of newly-discovered elements and their alloys, will be received with enthusiasm. It takes up the forms of minerals, crystals and their interesting formations, colors of the various substances, their fracture and cleavage, the chemical composition and classification of minerals, and the minerals themselves in scientific sequence. Especial attention is given to substances such as carnotite and partonite, which have but recently acquired economic importance. A feature of the work is its Americanization by an expert, who tells just where each mineral occurs and its American market and price. The text is a readable account in popular language, exceedingly helpful to the student and collector in enabling him to identify his own specimens.

MODERN UNDERPINNING. Developments, Methods and Typical Examples. By Lazarus White, C.E., and Edmund Astley Prentis, Jr., E.M. New York: John Wiley & Sons, Inc., 1917. Price, $1.50 net.

In 1900, methods of underpinning were but crudely developed; since then the most wonderful achievements have been recorded, and it is these achievements that are set down from first-hand material by the writers of this book. The text of the work might almost be disregarded, and still the engineer might rapidly assimilate accurate ideas and precise methods from the illustrations alone. Particularly attention has been given to the New York subways construction, a shining example of combination between the best contracting and engineering talent. From historical consideration the book proceeds to specific instances, concluding with an appendix devoted to the problems of underpinning in rock and the special arrangement of pit boards. Dealing with what has become a most important phase of construction, the work makes available to engineers and contractors a fund of valuable information that might otherwise be inaccessible.

THE ADMINISTRATION OF INDUSTRIAL ENTERPRISES With Special Reference to Factory Practice. By Edward D. Jones, Ph.D. 8vo.; 448 pp.; illustrated. New York: Longmans, Green and Co., 1916. Price, $2 net.

The author has added another notable volume to his writings on business and economics, in which he takes us through the launching of the industrial enterprise, its location—an important factor in future efficiency, and the considerations that enter into the layout of a manufacturing plant and its power problems. There is a survey of the administrative history of American industry, leading to a general statement of present-day principles, and the functions and relationships of the higher executives are excellently set forth. Other chapters deal with cost accounting, the employment of labor, fatigue, the measurement of wage factors, and the newer wage systems. The various departments dealing with such matters as advertising, selling, and traffic are adequately explained, and the final chapter presents facts and methods relating to credit and collection. The author has been highly successful in his double aim, which has been "to trace the application of the scientific method in industry, and to point out the efficiency and the charm of an economic policy based upon welfare and service."

Oil Tests

Their relation to Correct Lubrication

This important 9 minute talk is based on the 50 years' world-wide experience of the Vacuum Oil Company

SEVERAL years ago a prominent engineer invented a machine to determine the comparative efficiency of lubricating oils. But one day it was found that crude kerosene oil, by this machine's test, was the best lubricant.

That, of course, was ridiculous on the face of it.

This will indicate the difficulties which science has always met in trying to judge an oil's efficiency by anything but the practical tests of *service*.

Nevertheless, *during manufacture*, certain scientific tests are essential.

Gargoyle Lubricants, whether they are intended for steam engine use, gas engine use, or use on other friction surfaces, are all put through many such scientific tests.

For example: Each batch of Gargoyle Mobiloils which goes on the market, is put through at least 35 separate and distinct tests.

These tests are *not* aimed to get at the *lubricating efficiency* of the oil. The oil's efficiency had to be arrived at by long experiment in practical use.

The scientific laboratory tests simply make sure that the oil is running uniform—that every batch manufactured is up to the proven standard.

Below we outline briefly a few of the tests used for this purpose.

IMPURITY AND WATER TEST

Crude oil comes from the ground. It is liable to contain traces of salt, mud, sand, water and other foreign substances held in suspension.

The crude oil which is subjected to this test is mixed half and half with gasoline and poured into a graduated glass sedimentation jar. The jar is then put into a centrifuge and whirled.

During the whirling process the bottom of the jar is thrown outward. The water and foreign substances are forced into the small graduated end of the jar. The organic foreign substances form a layer between the water and the oil, the sand sinking to the bottom.

The graduated scale indicates the percentage of water and of foreign substances in the sample under examination.

GRAVITY TEST

In this test a weighted bulb with a graduated spindle (hydrometer) is dropped into a tube of oil. The hydrometer floats. But its bottom sinks to a certain depth—depending on the oil's gravity. The gravity is determined by the depth to which the hydrometer sinks, as shown by the markings on the spindle with the oil at 60° F.

This test is simply used to determine whether or not uniform weight per gallon is being maintained. It is constantly used in manufacturing Gargoyle Lubricants.

FLASH AND FIRE TESTS

The flash test is the lowest temperature at which the vapor from an oil will ignite but not continue to burn.

If the flash test is too low, the oil will evaporate from the cylinder walls and bearings when the normal engine heat develops. This would leave the friction surfaces without lubrication.

Gargoyle Lubricants always undergo this flash test.

The fire test is made with the apparatus used in the flash test.

The fire test is the temperature at which the ignited vapor from an oil will continue to burn.

This is another check used in manufacturing Gargoyle Lubricants to insure uniformity.

But it should be remembered that the flash and fire tests alone cannot determine an oil's lubricating efficiency.

POUR TEST

The pour test is the lowest point of temperature at which the oil will flow. This is also known as the Cold Test. Below its pour test, oil forms into a soft, jelly-like substance that will not flow.

This test is used to make sure that every batch of Gargoyle Lubricants is meeting the established pour test standard.

CLOUD TEST

The oil is put into a screw-capped glass jar. A thermometer passes down through the cover into the oil. The jar is immersed in ice. The oil then gradually cools.

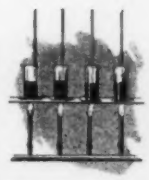
The cloud test is the temperature at which a cloud first forms in the oil and rises about half way up when it about covers the bulb of the thermometer. Its reading is given as the cloud test.

This is a laboratory test constantly used in manufacturing Gargoyle Lubricants.

COOK TEST

Oil can be decolorized by these methods:

(1) *By Chemical Treatment.*
(2) *By Filtration.*
(3) *By a combination of both.*



In filtration Gargoyle Mobiloils are passed through filters containing 20 tons to 50 tons of fuller's earth.

The cook test determines whether the purification after treatment is complete.

The oil for testing is put in a glass beaker. There it is heated for one hour up to 450° F. The oil is then examined for discoloration and sediment.

The original color of the oil gives no real guide to its lubricating efficiency. Nor does it give a real guide to the carbon content. But, under this cook test, a change from the original color of the oil indicates the degree of incomplete purification.

Under this test the contrast between the discoloration of most oils and the slight discoloration of Gargoyle Lubricants—Gargoyle Mobiloils for example—is very marked.

VISCOSITY TEST

Viscosity is simply the technical name for what is popularly called "body."

But this fact must be borne in mind: Two oils which will show the same viscosity at one temperature will often decidedly differ in viscosity at higher or lower temperatures.

The viscosity of Gargoyle Lubricants is tested at three different temperatures —104°—140° and 210° F.

In this test the oil is put into a tube surrounded by water or steam which is kept at the test temperature. When the oil reaches the predetermined temperature, a plug in the bottom of the tube is removed. This opens a small standardized tube. The oil is then allowed to flow out of this opening into a glass receptacle of known capacity.

The time in seconds required by the oil to fill the container beneath, up to the standard graduation mark, is the measure of the oil's viscosity.

Gargoyle Lubricants all go through the viscosity test, but the viscosity test alone cannot determine the efficiency of an oil. Gargoyle Lubricants possess individual characteristics as lubricants.

So much for "tests".

We have tried to make plain the great difference in efficiency which may exist between oils which *look* alike, *feel* alike and *test* alike. To cope with this puzzling condition, the Vacuum Oil Company has for years maintained thoroughly equipped laboratories and engineering departments in many parts of the world.

In recommending a Gargoyle Lubricant for a given purpose, we first analyze the operating conditions to be met, then specify the lubricant which is known, from practical experience, to meet the conditions most efficiently.

With Gargoyle Mobiloils this situation is met by a Chart of Recommendations which is shown in part on this page. The oils specified for the various cars in this Chart are determined annually by a careful engineering analysis of each model and make of car.

The recommendations are based on 50 years of practical experience in lubrication. The formulæ and methods used in manufacturing these oils are based on almost numberless practical tests.

You may safely feel that the oil specified for your car in this chart will insure—

Greater power.
Less friction.
Less carbon.
Lower consumption of gasoline.
Less consumption of lubricating oil.
Longer life of your car.

Write for new 56-page booklet containing complete discussion of your lubrication problems, list of troubles with remedies and complete Charts of Recommendations for Automobiles, Motorcycles, Tractors and Marine Engines.

Mobiloils

A grade for each type of motor

In buying Gargoyle Mobiloils from your dealer, it is safest to purchase in original packages. Look for the red Gargoyle on the container. If the dealer has not the grade specified for your car, kindly write our nearest branch, giving dealer's name and address.

VACUUM OIL COMPANY, Rochester, N. Y., U. S. A.

Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world.

Domestic Branches: Detroit New York Philadelphia Minneapolis Boston Chicago Indianapolis Pittsburgh Kansas City, Kan. Des Moines

Correct Automobile Lubrication

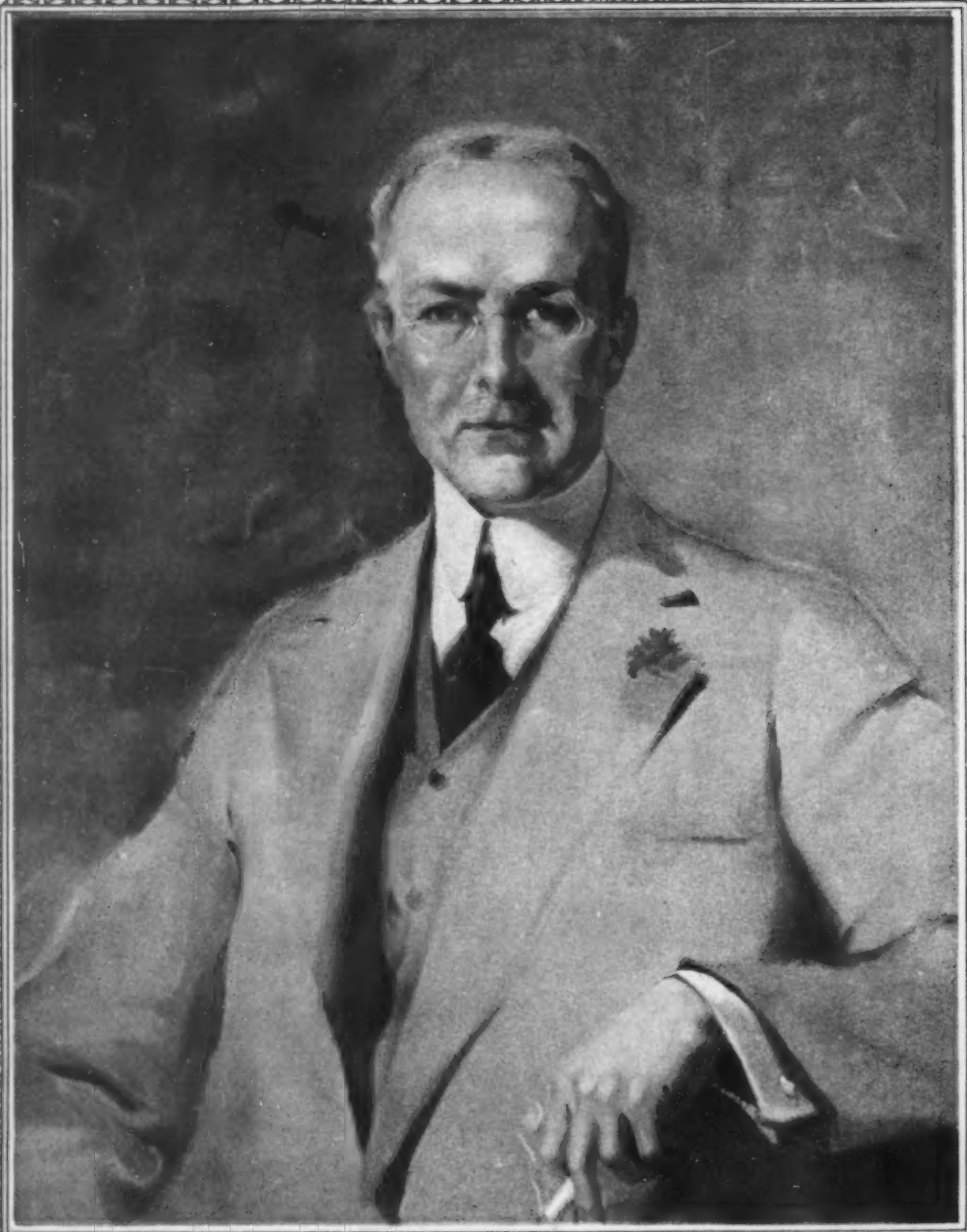
Explanation:—The four grades of Gargoyle Mobiloils, for engine lubrication, purified to remove free carbon, are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil "Arctic"

In the Chart below, the letter opposite the car indicates the grade of Gargoyle Mobiloils that should be used. For example, "A" means Gargoyle Mobiloil "A," "Arc" means Gargoyle Mobiloil "Arctic," etc. The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

Model of CARS	1917 Pleasure Car	1917 Motor Truck	1916 Pleasure Car	1916 Motor Truck	1915 Pleasure Car	1915 Motor Truck	1914 Pleasure Car	1914 Motor Truck	1913 Pleasure Car	1913 Motor Truck
Abbott-Detroit	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (8 cyl)			A	A	A	A				
Allen	A	Arc	A	Arc	A	Arc	A	A	A	A
" (Mod. 33-34-35)					A	Arc				
American Six	Arc	Arc								
Apperson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A						
Auburn (4 cyl)			A	Arc	A	Arc	A	A	A	A
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Autocar (2 cyl)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Avery			A	A	A	A	A	A	A	A
" (Mod. 5 & C 1 ton)			Arc	Arc	Arc	Arc	Arc	Arc		
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc		
" (8 cyl)			A	A						
Buick	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
Cadillac							Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	Arc	Arc				
Case	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Chalmers			Arc	Arc	Arc	Arc	A	A	Arc	Arc
" (Mod. 6-40)			A	Arc						
" (Mod. 6-35)	A	A	A	A						
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Chase (air)			B	B	B	B	B	B	B	B
Chase (water)	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	A
Cole			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Cunningham					Arc	Arc	Arc	Arc	A	A
" (8 cyl)	A	A	A	A						
Daniels (8 cyl)	A	A	A	A						
Dart	A	Arc	A	Arc	Arc	Arc	A	A	A	Arc
" (Mod. C)	A	Arc	A	Arc	A	Arc	A	A		
Delaunay-Belleville					B	A	B	A	B	A
Detroiter	Arc	Arc	Arc	Arc	A	Arc	A	A	A	Arc
" (8 cyl)					Arc	Arc				
Dodge	A	Arc	A	Arc	E	E				
Dort	A	Arc	A	Arc	A	Arc				
Empire (4 cyl)	A	Arc	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6 cyl)	Arc	Arc	Arc	Arc						
Federal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Fiat	B	A	B	A	B	A	B	A	B	A
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	Arc
Grant	A	Arc	A	Arc	Arc	Arc	Arc	Arc		
H. A. L.	A	A	A	A						
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl)	A	A	A	A						
Hollier (8 cyl)			A	A	A	A				
Hudson			Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (Super Six)	A	Arc	A	A						
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
I.H.C. (air)					B	A	B	A	B	A
I.H.C. (water) (2 cycle)			A	A	A	A	A	A	A	A
I.H.C. (water) (4 cycle)			A	Arc						
Interstate	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Jackson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Jackson (8 cyl)	A	A	A	A						
Jeffery	A	Arc	A	Arc	A	Arc	A	A		
" (Chesterfield)			A	Arc	A					
" Com'l	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Jordan	Arc	Arc								
Kearns			E	E	E	E				
" Com'l	A	Arc	A	Arc	A	Arc				
Kelly Springfield	A	A	A	A	A	A	A	Arc	Arc	Arc
King					A	Arc	A	A	A	E
" (8 cyl)	A	A	A	A	Arc	Arc				
" Com'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Kissel Kar	A	Arc	A	Arc	A	Arc	A	A	A	Arc
" " Com'l	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" " (Mod. 48)			A	A	A	A	A			
Knox			B	A	B	A	B	A	B	A
" (Mod. 35)	A	A	A	A	A	A				
Lexington	Arc	Arc	Arc	Arc	Arc	Arc				
Liberty (Detroit)	Arc	Arc								
Lippard Stewart	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. M)	A	Arc	A	Arc						
Locomobile	E	E	E	E	E	E	E	E	Arc	Arc
Marion Handley	Arc	Arc								
" (Mod 6-40)	A	Arc								
Marmon	A	A	A	A	A	A	A	A	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	Arc	A	Arc	A	Arc
" (22-70)					Arc	Arc				
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Mitchell (8 cyl)			A	A						
Moline									A	Arc
" Knight	A	A	A	A	A	A				
Moon (4 cyl)					Arc	Arc	A	Arc	Arc	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Murray (8 cyl)	A	A								
National	Arc	Arc	A	Arc	A	Arc	A	A	A	A
" (12 cyl)	A	A	A	A						
Oakland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (8 cyl)			A	A						
Oldsmobile			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6 cyl)	A	A	A	A						
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Owen Magnetic	A	Arc	A	Arc	A	Arc				
Packard					A	Arc	A	Arc	Arc	Arc
" (12 cyl)	A	A	A	A						
" Com'l	A	A	A	A	A	Arc	Arc	Arc	Arc	Arc
Paige					A	Arc	A	A	A	E
" (6-46)	Arc	Arc	Arc	Arc	Arc	Arc				
" (6-35 & 38)	A	Arc	A	Arc	A	Arc				
Pathfinder	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (12 cyl)	A	A	A	A						
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A						
Pierce Arrow	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" Com'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	Arc	A	Arc	A	Arc	A	Arc
Pullman	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	Arc	Arc					
Renault			A	Arc	A	Arc	A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Richmond	Arc	Arc	Arc	Arc	A	Arc	A	Arc	Arc	Arc
Riker	E	E								
Saxon	E	E	E	E	E	E	E	E		
Scripps-Booth (air)							B	A		
" " (water)	A	Arc	A	Arc	E	E				
" " (8 cyl)	A	A	A	A						
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Simplex	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
Standard (8 cyl)	A	A	A	A	A	A				
Stearns-Knight	A	A	B	A	B	A	B	A	A	A
" (8 cyl)	A	A	B	A						
Sterling (Wisconsin)	A	Arc	A	Arc						
Studebaker	A	Arc	A	Arc	Arc	Arc	A	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	Arc	Arc
Velie (4 cyl)			A	Arc	A	A	Arc	A	Arc	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Vim	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Willys-Knight	A	A	B	A	B	A	A	A		
Willys Six	Arc	Arc								
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

Electric Vehicles—For motor bearings and enclosed chains use Gargoyle Mobiloil "A" the year 'round. For open chains and differential, use Gargoyle Mobiloil "C" the year 'round. ***Exception***—For *winter lubrication* of pleasure cars use Gargoyle Mobiloil "Arctic" for worm drive and Gargoyle Mobiloil "A" for bevel gear drive.



FATIMA may never become the *only* cigarette smoked by keen, substantial men of this type. But you will find that Fatima has already become more popular with such men than almost any other cigarette.

This is because men who smoke wisely want a SENSIBLE cigarette —a cigarette that is cool and comfortable to the tongue and throat and that leaves a man feeling "fit" and clear-headed even though he may smoke more often than usual.

Liggett & Myers Tobacco Co.

FATIMA

A Sensible Cigarette

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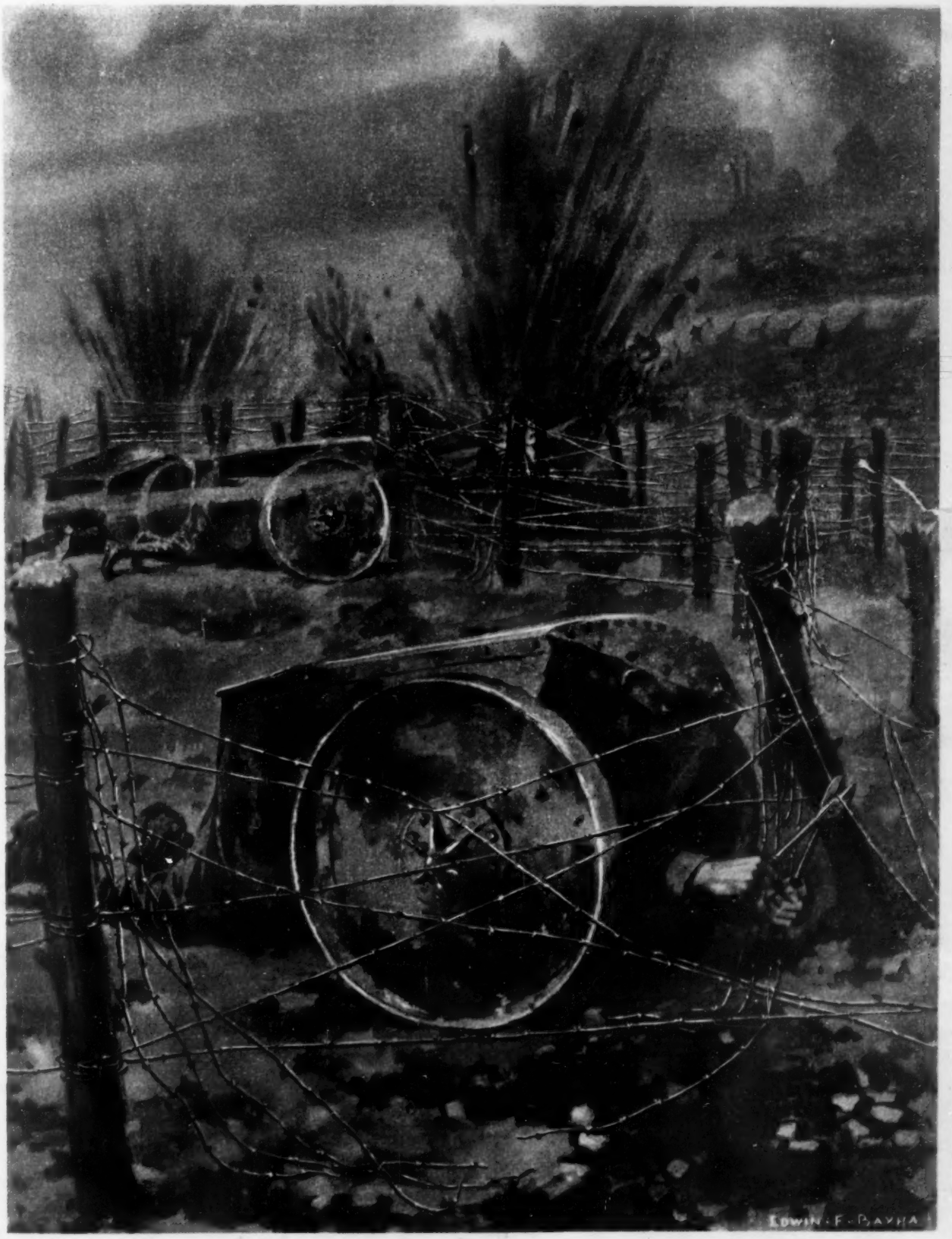

A ONE-MAN "TANK" FOR THE BARBED-WIRE CUTTER.—[See page 376]

April 14, 1917

Munn & Co., Inc., Publishers
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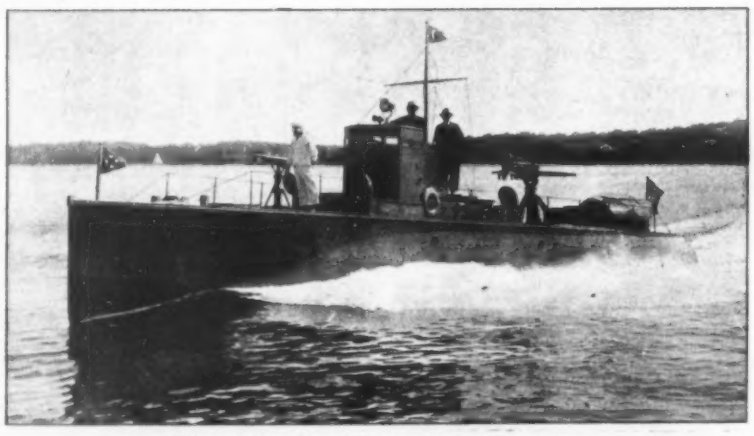

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